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Modern Methods of Painting Machine Tools

By Douglas T. Hamilton

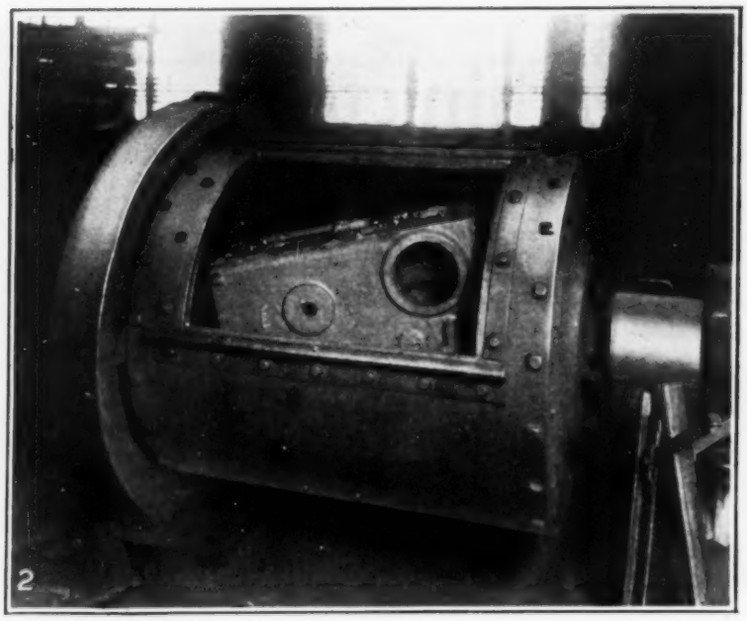
Painting machine tools at present-day production rates is no longer a haphazard job—It demands specialized processes and set routines comparable to those employed by and followed in the production departments

PAINTING machine tools as a part of the regular routine of production in a machine tool shop may be divided roughly into two distinct operations: (1) Getting the castings ready for the painter; (2) applying the filler and paint. The practices in regard to these operations as outlined in this article are followed in the shops of the Fellows Gear Shaper Company at Springfield, Vermont, to finish the cast parts of the high-speed gear shaper made by that company.

Castings when taken from the mold are, even under favorable conditions, rather rough and crude in appearance, and considerable snagging, chipping, etc., are necessary before they are ready to be machined. Air-operated chipping chisels are employed as shown in Fig. 1 to remove sprues, fins and other surface irregularities, especially from places difficult to reach with a portable grinding wheel. On large castings the roughest of the sand and scale is removed by the sand-blasting process. If the casting is not too large it is then placed in a tumbling barrel as shown in Fig. 2, where it is tumbled with jackstones, further to remove the scale. It is interesting to note that the tumbling barrel produces a surface much more suitable for filling and painting than does the sand blasting, because the sand blast actually cuts into the casting whereas the tumbling barrel smooths it by removing excess projections. Even after sand blasting and tumbling, more or less sand still remains imbedded in the iron and if the filler or paint were to be applied at this stage, rusting might ensue and cause it to flake. Therefore the practice in this shop is to go over every inch of the surface of a large casting with a portable grinding wheel, or, on castings small enough to be handled conveniently, to grind them on the wheel of a fixed stand, thus smoothing all of the surface upon which no machining is to be done.

To prevent the casting from rusting while it is being machined it is now given a thin priming coat with an oil base primer, which is applied with a hand brush. This coat dries rapidly and forms a good base for the filler that is put on after the machine work is done. On those parts of the machine where pump or force-feed lubrication is employed it has been found advisable to seal the pores of the inside of the casting so as to prevent any sand that might remain in the iron from working into the lubricating oil and getting into the bearings. The bed, by which many of the principal working members of the high-speed gear shaper are inclosed, is therefore coated inside with a white, oil-proof paint to seal the pores of

Fig. 1—Preparatory work upon the castings destined to be painted is highly important. They are chipped with air-operated chisels, sand-blasted, tumbled in barrels, and sandpapered by hand



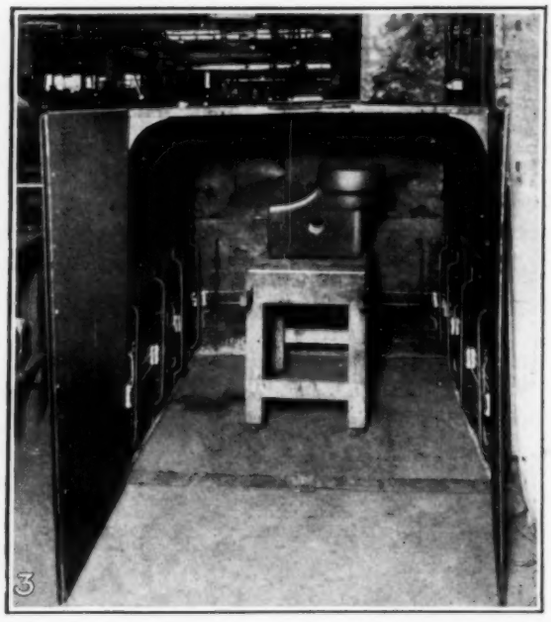


Fig. 2 — Castings not too large to prohibit such treatment are placed in tumbling barrels with a quantity of jackstones and rolled for several hours. Surfaces produced in this way are in excellent condition to hold the paint. Fig. 3—After the filler coat is put on it may be allowed to dry in the air, but the drying may be expedited by gentle heat in electrically heated ovens such as the one shown

the iron as previously mentioned. This operation is accomplished by means of an air gun. As the castings are completely machined before they come to the filling operation, masks are used over machined parts to which no filler is to be applied, and screw holes are plugged so that they will not be clogged with the filler. In some cases instead of using masks a slush is applied to the machined parts to prevent the filler from adhering to the iron. The slush can be removed easily after the filler is dry.

Before the filler is applied, the castings are carefully cleaned by an air jet or by suction, as the case may require. Many grades of filler have been tried in an endeavor to get one that is suitable for this purpose. The filler should be so compounded as to harden quite rapidly, and yet not so rapidly that it sets from the outside before it sets close to the iron, else it will have a tendency to flake. The filler is applied to the casting with an air gun. For the best results the filler should be mixed with gasoline. It dries much faster when so compounded and also spreads more evenly. The filler is put on thickly enough so that all of the high spots are covered and a fairly even surface produced. Following the filling operation the paint is allowed to air-dry from 12 to 15 hours, the time depending upon atmospheric conditions. It has been found recently, however, that better results can be obtained if the filler is baked in an electric oven at a temperature varying from 100 to 120 deg. with a free circulation of air. A satisfactory baking oven, illustrated in Fig. 3, is heated by eight heating units, and cuts down the drying time to about three or four hours.

After the filler is fully dried, the larger surfaces are smoothed with a portable disk sander as illustrated in Fig. 4. Parts that cannot be reached by a power sander are finished by hand with 120-grain silicon-carbide paper. Ordinary sand paper or emery cloth will not answer for this purpose because of the closeness of the grain and the consequent tendency to load rapidly. On this special paper the grains are arranged more openly, so that it is freer cutting and works faster. Paper is preferable to cloth for the reason that it can be easily torn into the sizes wanted and is more convenient to handle. Paper does not last long, but is cheaper.

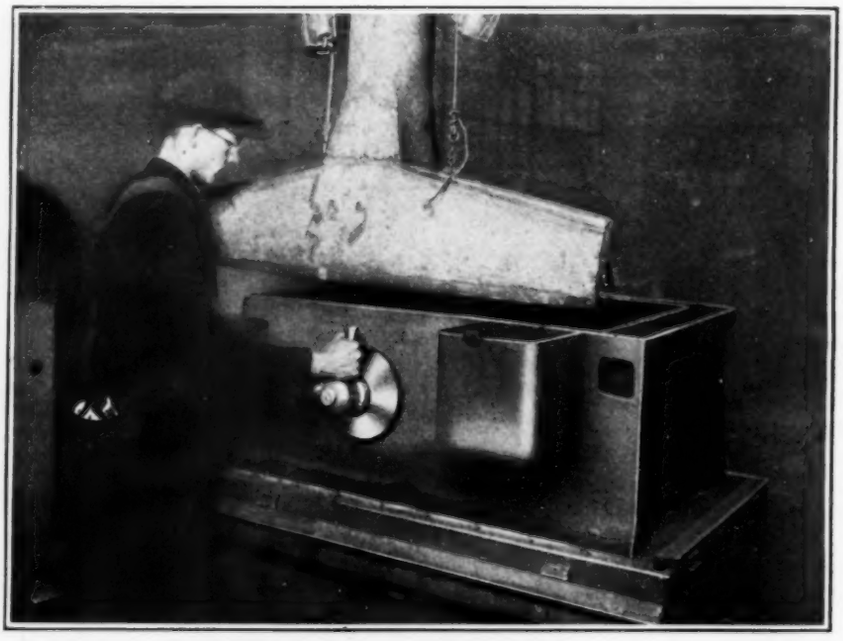


Fig. 4 — Broad surfaces are gone over with a power driven disk sander, which smooths the now hardened surface of the filler and puts it in good condition to receive the finishing paint. A coat of shellac or shellac substitute follows this operation to prevent the somewhat porous filler from soaking up oil while the assembled machine is under test just before shipment

Fig. 5 — After the machine is assembled any bruises or abrasions that may have been made by accident in the filler coat during the work are filled with a pyroxylin putty and the surfaces again sandpapered by hand

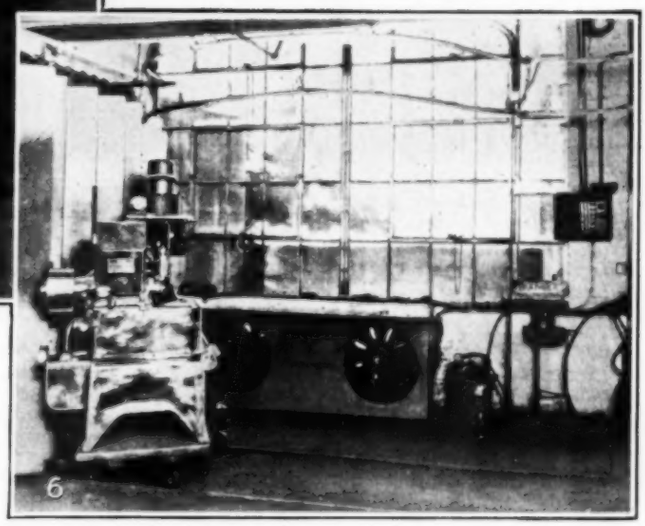


Fig. 6—The painting room is a space inclosed by folding sheet metal panels depending from a monorail. The machine is placed on a turntable for convenience of the operator. Fans exhaust the fumes from the room

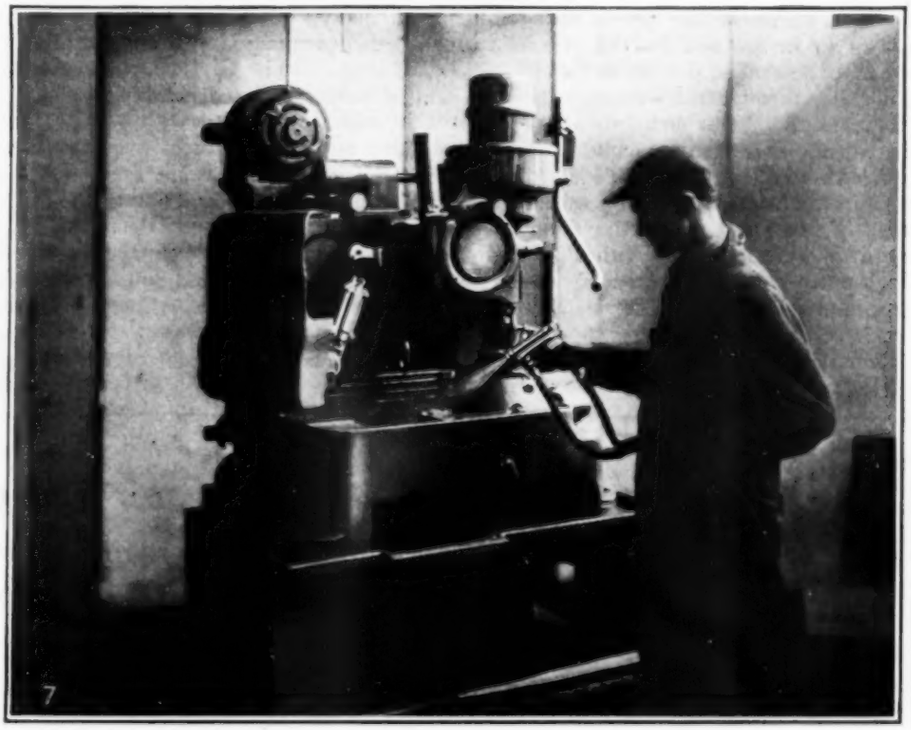


Fig. 7 — This illustration shows the high-speed gear shaper getting its final coat of paint from an air brush. Finish machined parts are covered with slush and then painted over the slush. The paint hardens and holds the slush in place, making an excellent coating to exclude rust, yet can be removed without any difficulty whatever by merely wiping off the surface with a cloth

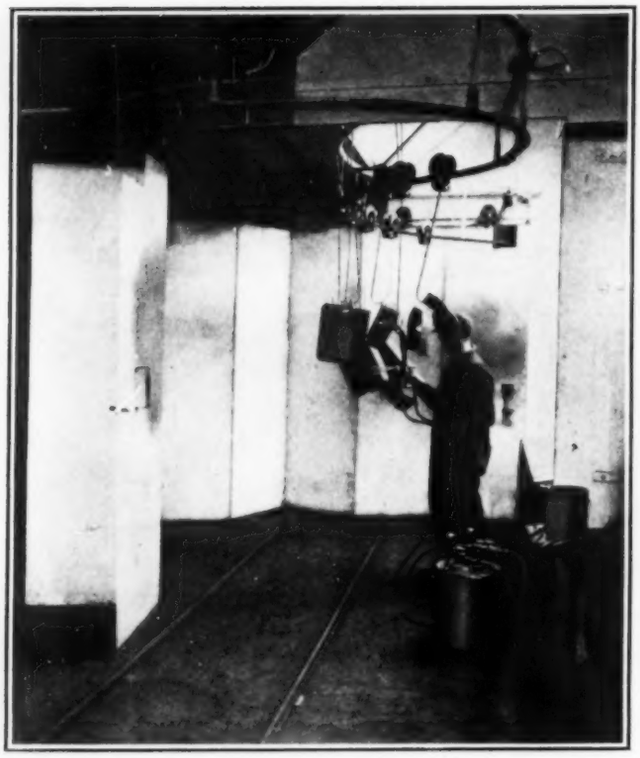


Fig. 8—Small parts are painted with the air brush while suspended from trolleys running upon a monorail. As the operator finishes each part, he pushes it along out of his way. The system of folding panels to inclose the paint room may be seen plainly

After this process of rough sanding, the castings are given another coat of primer similar to that given in the snagging room; this second coat being an oil primer, which seems to hold better to an oil base filler than does one containing turpentine. After drying, a coat of shellac or shellac-substitute is applied to prevent the filler from soaking up the oil which will inevitably get on the painted surface when the machine is being tested. Shellac or shellac-substitute seems to be difficult to apply with an air brush, and for this reason a broad brush is used and the shellac put on by hand.

In going through the assembly line the painted parts become more or less bruised, and oil and dirt collect upon them. After the machine is fully assembled and has been tested, the thickest of the oil is wiped off with rags and the machine carefully washed all over with gasoline. Parts from which the filler has been removed by bruising, etc., are filled with a pyroxylin putty applied with a putty knife. This material is better than ordinary putty, and seems to bond very quickly with the shellac. It can be sanded to a very smooth finish. The spots are covered in this manner and sanded as illustrated in Fig. 5, with the 120-grain silicon-carbide paper. Following this operation, the machine is again shellacked.

A rather interesting arrangement is used in connection with the painting room shown in Fig. 6, which is located at the end of the assembly and testing line. A truck runs down the line, carrying the machine from one stage to the next until it has been completely assembled and tested. At the end of the line there is a turn-table on which the machine is turned about and shifted along a track into the painting room where it is placed on a truck with a revolving platform so that it can be easily turned to whatever position is most convenient for the painter.

The painting room is provided with two fans to exhaust the fumes. This room can be completely enclosed by sheet-metal folding panels, suspended from trolleys which run on a semi-circular track. The painting is done with an air gun, as shown in Fig. 7; the room being closed by the panels so that the spray is not scattered throughout the plant. The machine is masked or slushed on all portions where no paint is to be put on; the masks covering the wheel on the door, the feed cam, etc., being clearly shown in the illustration.

Guards and other removable parts are painted separately. By the arrangement of trolleys shown in Fig. 8 they are suspended from a monorail upon which each part may be moved along after the painter has finished with it, and allowed to remain until dry. A painter can handle a large number of parts in this way and make a much better job with the air gun than he could hope to accomplish with the hand brush.

Two methods are adopted to keep the paint from adhering to the bright, or machined parts. One method is to slush all such parts and refrain from painting over them; the other is to slush them and paint right over the slush. The second method is recommended, as it practically eliminates the possibility of rusting.

A test was made to prove this. Two highly finished parts were slushed with the best grade of machine slush and on one of them a good heavy coat of enamel was spread over the slush. The two parts were then set out to weather. After a short exposure to heat, rain and sun, the part which was slushed but not enameled had a series of rings of rust on it, showing that the slush had slipped and exposed the bare metal to the elements. The part which was enameled over the slush was unaffected, although the enamel and slush were easily removed with a rag. This experiment proved that the enamel coat over the slush provides greater protection, which is an especial advantage where machines are to be shipped abroad, as it prevents the salt air from attacking any of the parts which might be exposed.

For the final finish a high-grade enamel is at present being used, but experiments have been made with lacquer finishes. A lacquer finish, of course, will cut down the time necessary for drying, but the experiments have not as yet been carried far enough to be certain that such a finish is as permanent as a high-grade enamel.

Preparing for Ford Production

How many new machine tools were needed for the Model A Ford? How many old ones were scrapped? How many were rebuilt? The answers will be found next week in the first article on the new Ford.

What Is Overhead?

MR. HOLLAND'S telephone rang vigorously. John Berger of the Excelsior Press Company, who has been trying to pull the company out of a hole and not finding it easy, wanted him.

"Can you sit in with us at a board meeting at two, tomorrow, Mr. Holland? I'm expecting a battle and I may need your support."

"Sure, Berger, I'll be there. Sort of enjoy an argument once in a while." The argument started soon after he arrived. In reply to a question Berger had just stated that overhead was three hundred and ten per cent.

"Something wrong with a shop, Berger, when overhead gets up that high." It was old man Williams—a retired foundry man. "Overhead never should exceed a hundred and fifty. And that's high. I always kept mine below that. Don't you think that's too high, Mr. Holland?"

"Overhead," said Holland, "is a funny sort of bird, when we base it on direct labor, as you have. It wouldn't sound so bad if you gave it in dollars and cents. But we do shy at high percentages What is your alibi, Berger?"

"Simply that labor costs are lower in proportion to other costs—so the percentage goes up."

"But you're paying higher wages than ever," broke in Williams.

"True, Mr. Williams, but labor costs are lower than ever. That's because we have better machines than before. But these machines cost a lot of money and that helps make the overhead more than before, when you base it on direct labor. It's the same with every shop I know of."

"What do you think, Holland?" asked Williams.

"A friend of mine put up the same line of argument the other day, Mr. Williams. He pointed out that in the old days labor was frequently the largest single item of cost and so made a very good basis for figuring overhead. But he agrees with Berger, that, as direct labor costs are now very small in most quantity production plants, direct labor is no longer a good base to use as it gives an erroneous impression. What is your suggestion, Mr. Berger?"

"Well, Mr. Holland, it seems to me we've got the low overhead idea so fixed in our minds that it's hard to think straight about the new conditions. Our overhead would be lower if we hadn't put in those new machines. But our costs would have been higher. It's a case where increased overhead pays. Seems to me we must either change our ideas about overhead, or get a new base."

"As how, Berger?" asked Williams.

"It could be a number of things grouped together, such as material and machine investment, or total cost of product, or total plant cost.

"Or we can put supervision, designing, and the things we sometimes foolishly call non-productive labor, either as labor or in a special group. Anyway, that will keep us from thinking we are wasting money when in reality we are saving it."

"What we use for a base doesn't matter so long as we understand just what it means," said Holland. "As Berger says, we shy at increased overhead when it really means that the base is lower, and not that we have been guilty of poor management. It's like getting used to paying a hundred dollars a month for a house that formerly cost us thirty or forty. Only, with overhead, it usually means that we are actually building machines at a lower cost."

Executives are invited to discuss the problem involved in the foregoing case. Accepted contributions will be paid for.

Discussion

The Privileged Class

Yes, we must admit that the "engineering mind" tends to act too slowly on rush jobs. Caution and accuracy have become such a part of many of us that we do not jar ourselves into quick

decisions when necessary. Does this mean that the "engineering mind" fundamentally canot act quickly under necessity? Positively not! What some of us need is the application of the same type of systems to our own work that we, as efficiency engineers, have applied to others. We need to *schedule* our work. When the rush job comes we should analyze it into a reasonable number of components, set completion dates for each, *and live up to them.* When we do this there will not be "an oppressive silence hanging over the little group in the works manager's office"—on our account, and Mr. Works Manager will not have to help Mr. Chief Engineer systemize his department. By an engineer who has tried it.

—W. H. SHIPMAN.

While in the case of the Atlas Corporation the outburst of the man Wales against the time-consuming methods of the engineering department was undoubtedly justified, the writer's experience in a number of varied industries has indicated that this department is only one of several offenders.

The tendency during past years has been to increase the efficiency of our manufacturing programs. Layout, equipment, methods and supervision have been studied, revised and improved with the one idea of producing better work more promptly and at a lesser cost.

Generally speaking, results have demonstrated the wisdom of this policy, and from the application of its principles the American industrial field has emerged as a wonderful example.

However, the actual yardstick that a customer applies to any company's service does not take cognizance of that company's shop efficiency as such, except perhaps as it applies to the quality of the work turned out.

What the customer sees is rather the time that elapses between the mailing or delivery of his order and the shipment of the finished goods. And it is something entirely different from production efficiency, or perhaps in addition to it, which determines the rating on such a basis.

Sales, credit, engineering and order departments, all take their innings at an order before the production end of a business gets its chance, and these, in conjunction with a purchasing and shipping delay, can easily accumulate a time delay far in excess of that occasioned by the actual production of the parts.

An analysis by the writer some years ago of a certain group of orders coming into a well-known Mid-Western shop showed that considerably less than one-half of them involved productive work in excess of a single day. Yet in the course of office routine, the various moves of records and data relating to these orders between non-productive departments was consuming anywhere from three to five days.

Now this is not cited as a positive relationship but merely to illustrate the point which I wish to make; namely, that while it is necessary and commendable to increase production efficiency there is a big field for definite improvement in the average manufacturing company with reference to cutting down the time which now tends to penalize a customer service through the delay in conformity to office routine.

A lot of this routine, perhaps all of it, may be necessary in securing for record those details that must be retained as guides in the future conduct of a business; but every effort should be made to see that the obtaining of these data in no way holds up the main income-producing activity of the business, which is the prompt delivery of saleable or ordered goods to the customer.

—D. C. WRIGHT.

Setting Prices on Special Machines

There is no problem to be solved between manufacturer and purchaser at which they are farther apart at its inception than that of pricing special machines. In the first place, the purchasing agent is often unwittingly misled by his engineering department, which calmly advises that the machine is similar to a standard machine with just a few changes. A detailed examination will often disclose that rather than list the points of variation, it would be easier to list the points of exact agreement. A manufacturer who knew his purchaser well enough not to risk offense might often profitably ask for such a detailed list. The results would be enlightening.

Of the two plans suggested by Mr. Holland, I would dismiss the second rather quickly, because a contract which might lead to ill feeling or possible legal action in order to carry it out to its full limit at a future date, as a protection for present business, is not a good one to enter into knowingly. The first I heartily endorse for its squareness and straightforwardness, but I fear for its success as far as the purchaser is concerned. But, if I were the manufacturer, I would do a little extra work before I even presented the first plan. I would endeavor to find out just what the semi-special machine is intended to do, and then I would make a hurried survey of the possibility of doing the job with the standard machine plus special extra attachments or replacements. Then if this were feasible, I would present the standard machine plus full costs for attachments as an alternative to the semi-special machine.

It may seem like a long shot at first hand, but it's easy to admit the possibility of the man who has been working with a certain line of machines of his own manufacture for years being in a better position to design variations for special purposes than the designer who perhaps studies the machine for the first time on this particular job. The advantages of the standard machine with attachments to both manufacturer and purchaser are rather obvious, and need no further discussion. It may be only a possibility, but it's worth trying.

—JOHN W. CAMPBELL.

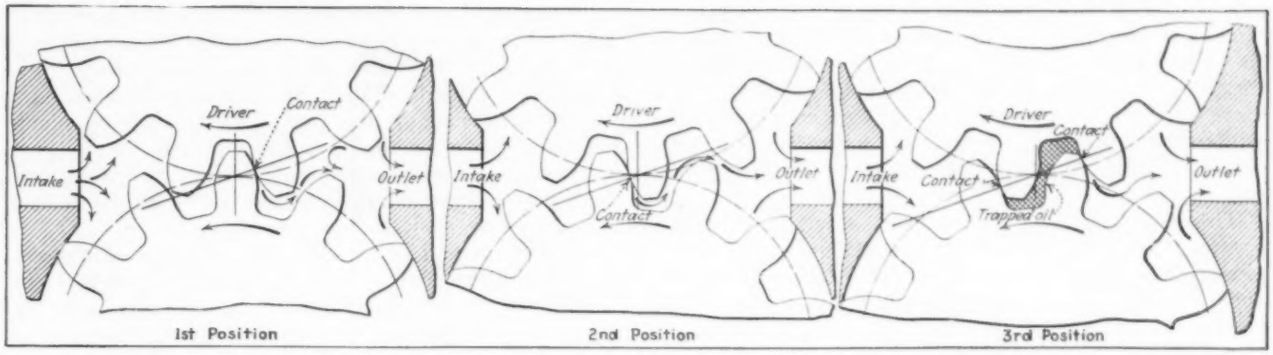


Fig. 1—Three stages of tooth mesh conditions of a pump made up of spur gears of conventional involute form

The Design of Geared Pumps

By EARLE BUCKINGHAM

Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

Limitations of the conventional involute form of tooth for pumping service—Helical gears of segmental tooth form are proposed and calculations of the form of the basic rack to generate them given

THE simplest design of a pump to handle liquids consists of a pair of gears running together in a tight case. Pumps of this type are widely used on machine tools to supply the cutting oil or coolant to the tool and also to supply lubricating oil under pressure in various types of force-feed lubrication systems. Modifications are often made in the design of such pumps to adapt them for use as gas compressors for small refrigerating units and also to supply a liquid under pressure for various types of hydraulic units. In fact a geared pump is usually the first to be considered when a small and simple pump is required.

The characteristics of the tooth action best adapted to transmit power and that required to handle a liquid are quite different in many respects. Thus, the major requirement of a pair of gears to transmit power is to maintain contact between the mating teeth along a fixed line of action so that continuous and uniform rotary motion is transmitted from one gear to the other. This condition of uniform motion is also a requirement of a pair of gears used for pumping purposes, but it is of secondary importance here. The primary function of the tooth action between a pair of gears used for pumping purposes is to maintain a seal between the intake and outlet sides of the pump; hence the teeth act as rotary valves. It should be apparent that the tooth action of gears used for pumping purposes should be studied as an individual problem by itself, if the most effective design for this purpose is to be attained. We will therefore study the meshing conditions of a pair of gears used for pumping purposes.

As a first example we will use a pair of 12-tooth spur gears of conventional tooth design. In Fig. 1 is shown the mesh of these gears in three successive positions, each at a 10-deg. advance from the preceding one. At the first position, the oil is forced back on the outlet side from the contact line as indicated by the arrows. In this position, the oil has a relatively free path of escape. In the second position, another tooth of the driven gear has started to enter the space of the driving gear and interferes somewhat with the free escape of the oil. In the third position, the second pair of mating teeth has come into contact before the first pair has left contact, thus trapping the oil as shown in the shaded portion. The area of this space where the oil is trapped becomes smaller as the gears

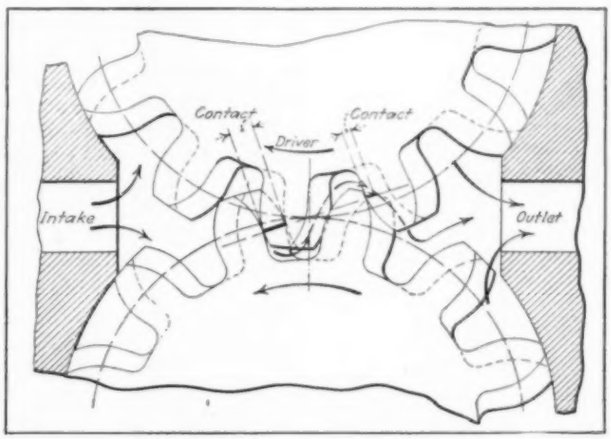


Fig. 2—Meshing conditions of a pump made up of a pair of helical gears of involute form

advance. The pressure thus set up by the trapped oil will force the teeth of the gear apart so that some of this trapped oil can escape. Most of it, if not all, will escape to the intake or low pressure side. Probably even more oil than that trapped between the two contact lines will escape to the low pressure side when the tooth contact is lost because of the pressure set up by the trapped oil.

This action takes place at every tooth mesh cycle: For example, with a pair of 12-tooth gears, it occurs twelve times each revolution of the gears. When the speeds are low, the principal result of this action is to reduce the amount of oil delivered. As the speeds increase, the proportionate loss in the amount delivered also increases and, in addition, the pump becomes noisy. Tests of the amount of oil delivered by a small pump with gears of this design running at speeds from about 100 to 2,000 r.p.m showed the following: At speeds up to about 1,000 r.p.m. the delivery remained almost directly proportional to the speed. Above this speed, the amount delivered began to be less than directly proportional until a point was reached where a further increase in speed gave no further increase in the amount delivered. Under these conditions, the pump was noisy and the temperature of the oil began to rise very rapidly with any further increase in speed.

It is evident from the foregoing that one of the primary requirements of the tooth action of gears that will give the most effective pumping action is that such tooth action must avoid trapping.

It should be evident also that the capacity of such pumps as the foregoing, assuming no slippage or leakage, is very nearly equal to the volume of the teeth from their tips to their working depth. The volume of the oil carried around in the tooth spaces is not a measure of the capacity of such pump gears. The oil delivered represents primarily the volume displaced by the teeth of the gears entering into their mating tooth-spaces.

In order to prevent trapping with involute spur gear teeth, it is necessary to reduce the amount of contact to a single tooth interval or slightly less. Under these conditions only a single contact line will be maintained during any movement of the gears. Tests made on pump gears of this design show a delivery almost directly proportional to the speed up to speeds of about 2,000 r.p.m. Such gears, however, may become noisy at the higher speeds because of their short contact.

Another method of avoiding this trapping is to make the pump gears with a slight helix angle, usually from 5 to 10 deg. is sufficient. Such a pair of gears is shown in Fig. 2. The contact line on spur gears is parallel to the axis of the gear, whereas on helical gears it is at an angle to the axis. Thus when the second pair of mating helical gear teeth comes into contact, this contact starts at a corner of the tooth, as indicated in Fig. 2, and still leaves a passage for the oil to escape as shown by the arrows. By the time that the contact line on the second pair of mating teeth extends entirely across the face of the gear, contact should cease on part of the face of the first pair of mating teeth, thus permitting the trapped oil to escape to the intake side. If the helix angle on such gears is too great, however, and contact does not exist across the face of the first pair of mating teeth as the second pair are coming into contact, there will be leakage from the outlet side to the intake side through the passage thus opened up, and the amount of oil delivered will be reduced. Tests made on helical gear pumps show a delivery at speeds up to about 2,000 r.p.m. almost directly proportional to the speed. These gears, when properly made, operate quietly even at the higher speeds.

With all of the foregoing types of pump gears, the delivery is approximately equal to the volume of the gear teeth to their working depth. In addition, with all of these designs, the oil does not always have a free path of escape back from the seal or contact line. This condition causes relatively high fluid friction, particularly at

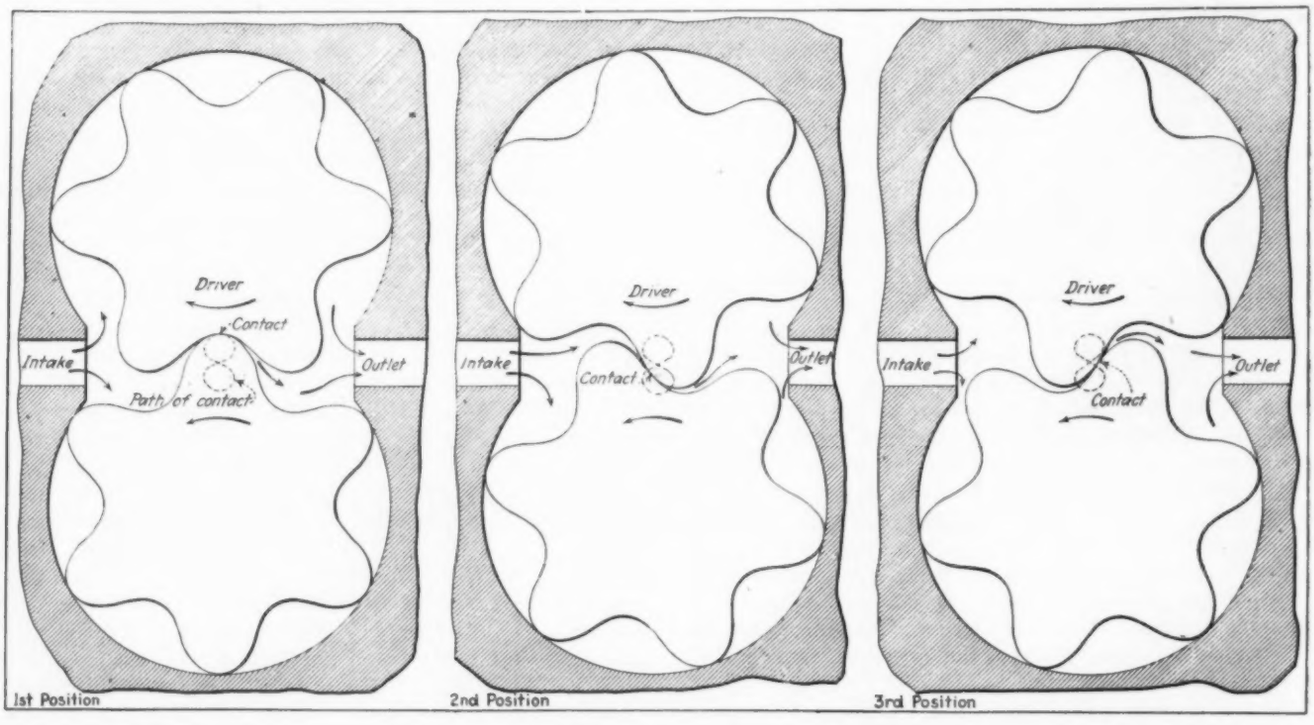


Fig. 3—Three stages of tooth mesh conditions of a pump having helical gears of segmental form

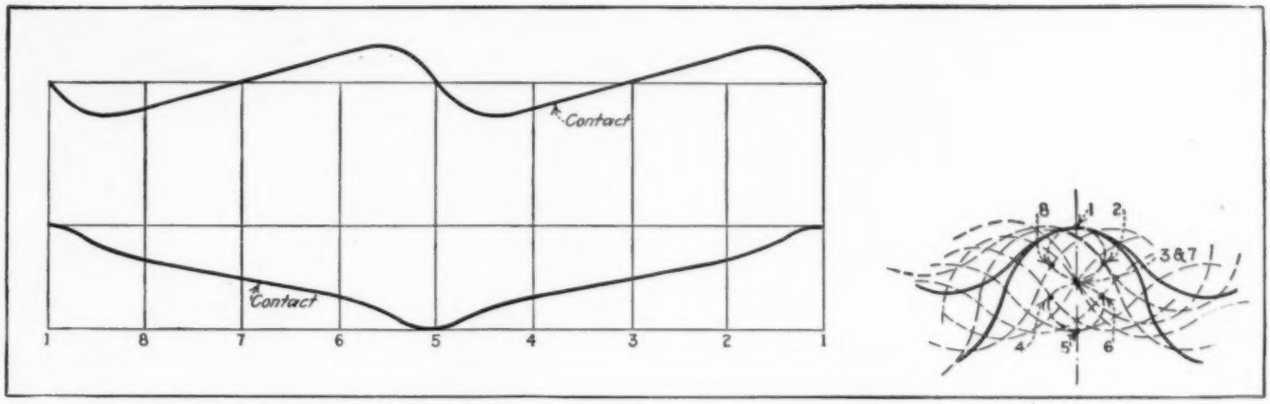


Fig. 4—Projection of the line of contact across the face of helical pump gears of segmental form

the higher speeds, and results in heating the oil appreciably. We will now consider the possibilities of gear tooth forms designed primarily for pumping purposes.

The ideal tooth form for pumping purposes must have a continuous and closed line of action lying inside the outline of the tooth profile. Such a tooth form will maintain a continuous seal or contact at the gear mesh on a single pair of mating teeth and trapping will be impossible. The full-cycloidal and the segmental tooth forms are two that meet this requirement. Such tooth forms, however, when applied to spur gears will not drive each other through a full tooth cycle because the pressure

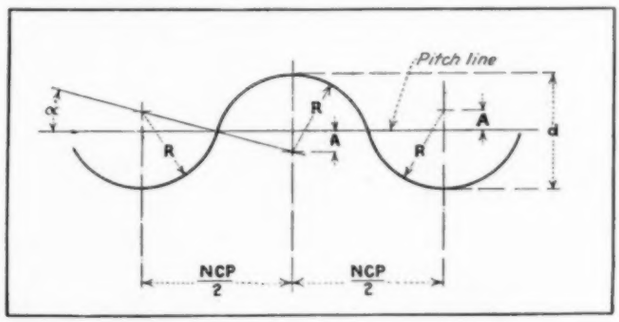


Fig. 5—Segmental basic rack form

angle rises to 90 deg. at two phases of the tooth mesh and also because for one-half of the action this pressure angle is negative. In order to make such gears self-driving, however, it is a simple matter to make them with helical teeth so that at all phases of the tooth mesh, the pressure angle at some point along the face of the gears is suitable to drive effectively. As the segmental form, whose basic rack is formed by true arcs of circles, is the simplest to manufacture, we will examine the meshing conditions on a pair of helical gears generated from a basic rack of segmental form.

As a definite example, we will use a pair of 6-tooth helical gears of segmental form. The mesh of these gears in three successive positions 20 deg. advanced from each other is shown in Fig. 3. It will be noted that there is no trapping of oil and that in all positions the oil has a free path of escape back from the contact or seal. The capacity of such pump gears is equal to the volume of oil carried around in the spaces between the gear teeth.

It will also be noted that only in the second position shown is the contact between the teeth satisfactory for driving purposes. Therefore the helix angle on these gears should be large enough to keep one pair of mating teeth in contact with each other at the pitch point along the helix for an angular distance approximately equal to one tooth interval. Under these conditions the rate of delivery of the oil will be uniform because all phases of the tooth mesh will exist at the different points along the face of the gear as shown in Fig. 4. This figure also shows the projection of the contact across the face of the gears.

We will now turn our attention to the form of the basic rack required to generate such pump gears. The rack form is shown in Fig. 5. Let

P_n = normal circular pitch
R = radius of basic rack form
A = distance from pitch line to center of radius
d = total depth of tooth
α = minimum angle of action
P_a = circular pitch in axial section
F = face width of gears
β = helix angle.

Then

$$P_n = P_a \cos \beta$$

$$R = \frac{P_a \cos \beta}{4 \cos \alpha} = \frac{P_n}{4 \cos \alpha}$$

$$A = R \sin \alpha$$

$$d = 2R(1 - \sin \alpha)$$

$$F = \frac{P_a}{\tan \beta}$$

Neglecting slippage, the volume of oil delivered by a pair of such gears would be as follows:

V = volume per revolution in cu.in.

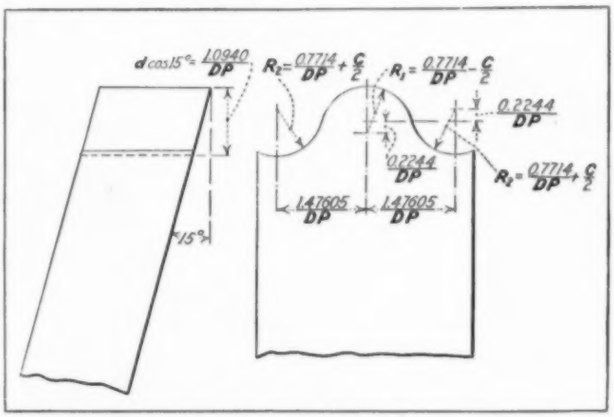


Fig. 6—Cutter with 15-deg. relief for forming a hob for segmental gear teeth

N = number of teeth.

$V = NP_a d$

The following values would be satisfactory for gears of I. D. P. For other sizes divide by the diametral pitch.

$\alpha = 15°$
$\beta = 20°$
$P_a = 3.1416$ in.
$P_n = 2.9521$ in.
$R = 0.7641$ in.
$A = 0.1977$ in.
$d = 1.1326$ in.
$F = 8.6315$ in.

However, $V = \dfrac{3.55\,N}{(\text{D.P.})^2}$

Hobs to produce these gears could be readily made by using a relieving tool of basic rack form. The foregoing is based on a true segmental form. In actual practice the relieving tool would be formed of true arcs of circles as these are the easiest to produce. Thus, with a true circular form on the relieved surface of the relieving tool, the form of its cutting edge would be oval. It would be symmetrical about the pitch line, however, and this symmetry is the only essential requirement. If the relieving tool has a relief of 15 deg., the form of the relieved surface of this tool would be as shown in Fig. 6, for example.

Some operating clearance between the teeth of the gears will be required and this can be obtained by making the radii of the relieving tool slightly different as indicated in Fig. 6. Thus when

R_1 = radius of addendum of relieving tool for hob, in.
R_2 = radius of dedendum of relieving tool for hob, in.
C = amount of clearance desired, in.

$$R_1 = \frac{0.7714}{\text{D.P.}} - \frac{C}{2}$$

$$R_2 = \frac{0.7714}{\text{D.P.}} + \frac{C}{2}$$

For small geared pumps, a clearance of from 0.001 to 0.002 in. would be sufficient. As these gears are driven by the contact at or near the pitch line along the helix, minor errors in tooth form would have but little influence except to increase the slippage slightly. The form is smooth and symmetrical and any distortion because of the hardening of the tools would be slight. If desired, the relieving tool for the hob could be ground after hardening on a master plate. Unground hobs, however, should be perfectly satisfactory.

Gears of this type have been used successfully as gas compressors on small refrigerating units, as they operate quietly and effectively at high speeds. They would be much more effective and satisfactory for geared pumps than are any gears of conventional tooth form, and would also make effective rotors for small superchargers of the Root blower type. As a matter of fact, this tooth form, in principle, is nothing more than the form that has long been used on such blowers, except that a helix has been introduced to make the gears self-driving and thus eliminate the need of a pair of driving gears to keep them in timed rotation with each other.

Full-Voltage Motor Starting

STARTING motors on full voltage has been standard practice for many years for motors up to 7½ hp. In fact in textile mills it is the practice to start motors up to 25 hp. in this way, and one prominent automobile manufacturer has been starting standard motors up to 75 hp. on full voltage. Cement plants have used this method for many drives, frequently involving motors up to 100 hp. Limitations of this method are not found in the motor design, but rather in the kva. taken from the line and in the strength of the connecting link between the motor and the load. While power-company-starting-current rules have in general not been materially changed in the last 12 to 15 years, and, therefore, users with one or two motors have been forced to retain current-reducing starters, the number of consumers with large connected loads has multiplied rapidly. In the plants of such consumers full-voltage starting can be and is practiced with large motors.

Where this method has been used, maintenance costs are low and no difficulty is experienced if proper application practices are followed. For belted loads ample-sized pulleys and belts, of course, are essential. Direct-connected drives offer no particular problems except with machines or devices that might be injured by the sudden application of a high starting torque. Chain- or gear-driven machines may have enough slack in the various parts as to make a different method of starting desirable.

High-reactance and high resistance squirrel-cage motors are now being designed for full-voltage starting. One of the chief aims in the design of these motors is to reduce the starting current to roughly 70 per cent of that of the ordinary squirrel-cage motor. The high-resistance rotor machine exerts approximately its maximum torque at starting and is, therefore, suitable for loads requiring high starting torque. However, its slip at full load is about three times greater than that of squirrel-cage motors. This limits its field to applications involving frequent starting and very short running periods or to loads having flywheels and rapidly recurring peak loads. For these applications the high-resistance, high-slip motor is ideal, as it permits the flywheel to deliver some of its stored energy to help carry the machine through the peak loads.

The high-reactance motor can be applied wherever the ordinary squirrel cage motor has been applied inasmuch as its initial starting torque is about the same and its maximum torque is at least 200 per cent of normal.

The development of these high-reactance motors has increased the field for full-voltage starting in three ways: First, the small power consumers have seized upon the combination of high-reactance motor and magnetic switch as a means of meeting the power-company-starting-current-rules and yet obtaining full automatic operation with low cost and utmost simplicity. In the second place, high-reactance motors can be designed with torque curves to fit the particular driven machine, eliminating the question of excess starting or maximum torque, and, therefore, also eliminating the necessity of a current- and torque-reducing starter. Third, the "high-torque, high-reactance" motors are being applied where, heretofore, only wound-rotor, or slip-ring motors have been used.

Excerpts from a paper by C. W. Falls, General Electric Co., presented at the Lehigh Valley Section of the American Institute of Electrical Engineers at Bethlehem, Pa., January, 1928.

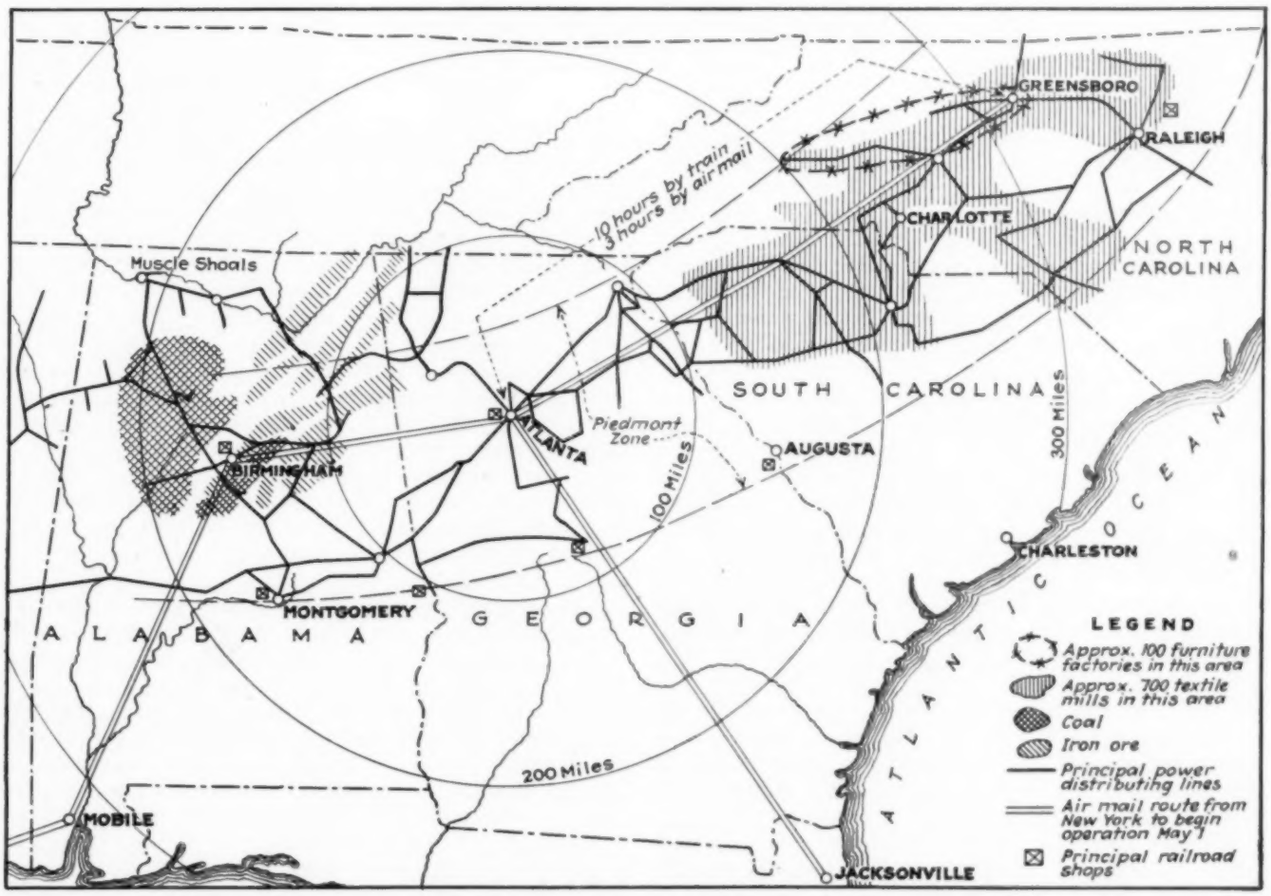
Machinery Development in the New South

By GEORGE S. BRADY
Associate Editor, American Machinist

A NORMAL increase of 500,000 additional kilowatts of electrical energy consumption in local industries in the next 12 years was the estimate recently made for the Birmingham district by one of the large power companies of the South. In other words, by 1940 the expected increase in the growth of manufacturing industries in north central Alabama will require additional energy equal to 75 per cent of the total generated power at Niagara, and since the estimate was made the actual industrial demands for power have regularly exceeded this figure. A little to the south, in the Montgomery area, six stations alone will supply more electrical energy to the developing industries than is furnished by Niagara to the industries in its section.

In the Charlotte district of the western Carolinas the rate of establishment of new industrial plants last year was one every 5 days, while this year the rate is reported as one new plant every 3½ days. Approximately 800 textile mills are now located through this Carolina section. Slightly to the north, in North Carolina, there has been developed one of the largest furniture centers in the world, with modern plants and machinery. Almost coincident with this, and centered from Winston-Salem to Durham, has been established the largest tobacco-products manufacturing center of the world, with extensive installations of the most modern labor-

Mechanical development is already a fact in the South. Abundant raw materials, power, and labor have brought the mills, and in their wake have come the contract machine shop and the machinery builders



Map indicating where industrial development is centering in the "Piedmont" South

saving machinery. In the Piedmont Carolinas over 7,000 manufacturing plants, with $1,100,000,000 invested capital, are in operation.

These are only a few of the high points of recent industrial development in the Piedmont, or foot-hill, region of the south eastern states. In this discussion other equally important districts may possibly be ignored, as it is merely intended by the analysis of one section to try to point out the factors that are now bringing about an industrial expansion that is comparable with the rapid growth of our western states after the Civil War. With the exception of the Birmingham section, where coal and iron have made possible an extensive steel center, the development of the South has not been primarily mechanical, but behind the influx and growth of textile, chemical, tobacco and lumber-products manufacturing plants, the machine shop has had rapid development, until it is now one of the important elements of the new industrial South. What has brought about these rapid changes? While some sections of the country are complaining of over-developed industries, excess capacity, and unemployment, how has it been possible for this district to take on new life and set its pace so that its industries are active and its building construction is at nearly twice the rate per capita that it is in other parts of the country? And while New England textile mills are running at a greatly reduced rate, how is it possible to operate the present mill capacity of this southern district at 130 per cent? Nor is this development confined to textiles alone. Winston-Salem, which is one of the fast-growing centers, claims to be manufacturing 68 different products at this time, and in Birmingham there are 522 manufacturing plants making a wide variety of products. In the manufacture of machinery and tools the Carolinas have nearly doubled their capacity in the last ten years, although this section does not offer as many advantages to the metal-working plant as the iron and steel region of Alabama. The reasons for this new industrial development in the South can readily be found in the opening up of the enormous natural resources of the region, the tremendous extent of cheap power, large resources of unused labor, and the reorganization and development of transportation.

While some sections of the country complain of over-capacity and unemployment, the Piedmont region of the South is building factories and turning out manufactured products at an increasing rate. Transportation, means of distribution, and port facilities are also being developed to transform this area into a most important industrial center

Even before the war the cotton manufacturing industry had been shifting to the South, where the raw material was at hand and labor was available. But according to the best authorities in various centers, it has only been in the last five or six years that the new industrial consciousness of the South has been aroused. While the early tendency was to bring in industries by transplanting from other sections of the country, the present aspect of the situation places more emphasis on the establishment of new plants and the expansion of existing ones.

Without going too deeply into these underlying economic factors, it is important to obtain a fair comprehension of them in order to visualize the background of the present metal-working expansion. The outstanding item has been the raw materials, and as the steel mills, chemical, textile and other plants were established the metal-working shops followed by natural evolution. Today the Piedmont South has a great number of contract machine shops, with here and there one that gradually found itself and is making a definite line of machines. In general, the mill machinery is still made largely in the North, but the repairs, improvements, and many new developments are being handled by local foundries and machine shops, mostly on contract. Notable exceptions to this, however, are sugar-mill machinery, which is being made on a large scale in several plants, and also cotton-ginning and baling machinery. A few shops have gotten to a production basis in the manufacture of textile-mill machinery, although this consists usually of smaller or special machines. Central Alabama might be considered as the natural center in which to look for extensive metal - working development. In the Birmingham district iron ore, coal, and fluxing limestone are found within a radius of 15 miles, and this close contact, supplemented by a mild climate, gives the district an advantage over other steel centers. The Warrior coal field, which is one of three distinct fields, covers an area of 3,500 sq.mi. lying northwest of Birmingham. Close to this are the red ore, or hematite, beds as well as large quantities of brown ore, and in between are the dolomite quarries, which stone is used as a flux in the manufacture of pig iron. There are 32 coke pig-iron furnaces in the state, with capacity for 4,000,000 tons. The production of coal is approximately 22,000,000 tons annually. The Birmingham district produces more than 4,000,000 tons of coke, and the chemical byproducts add considerable to the industrial wealth of the district. These include ammonia, benzol, toluol, creosote, and pitch. It is claimed that this locality will be one of the chief future centers for aniline dyes and coal-tar products. Explosives and fertilizers are also manufactured on a considerable scale. Because of its proximity to large phosphate rock deposits, and the cheapness of power, phosphorus products have become an important item, and in a similar manner the available bauxite has led to the development of an abrasive industry and a new center of aluminum production.

Cement production in Alabama now ranks eighth in the United States, six plants in the Birmingham district having an annual output of 8,000,000 barrels. Birmingham, moreover, is the large shipping point for soft woods, with numerous mills in close proximity. It is the development of these extensive resources with the attendant growth of mills of all kinds that has caused the opening up of a growing machine industry. It was stated that 85 new manufacturing plants were established in Birmingham city alone last year.

Because of the ready supply of iron and steel a considerable amount of heavy machine work is being done in the Birmingham district. This includes sugar mill

and refinery equipment for the Louisana sugar district, heavy casting work for the power plants, and all kinds of heavy repair work for the steel mills, railroads, chemical plants, textile mills, and oil-seed crushing mills. This has naturally led to the development of the building of other lines of machinery, and one plant is building heavy Diesel engines, while still another one is making a line of air compressors. Numerous small shops that began in this section on contract jobs from the mills have found that they could make and supply various articles of shop equipment such as pulleys and pumps, and also many machine parts, at more favorable rates than the mill could purchase them elsewhere. There has been, moreover, a natural growth of mill machinery building. As the mill operators developed or improved machinery the work was put out into the contract shops for building, and repeat orders then often led to the establishment of this machine building on a production basis. Every mill center now has some machine builders of this type. The favorable labor situation is one of the most outstanding advantages in the Southern industrial development, and no mere comparison of wage scales can adequately express its significance. There is a very considerable white population of sturdy Anglo-Saxon stock that has been engaged in primitive farming since Civil War days. It is claimed that 70 per cent of the population of Alabama, for instance, is still rural. These people have eagerly seized the opportunity of working in the mills, and statistics from several centers indicate that the production per worker exceeds that of workers in Northern mills where foreign labor has been predominant. On the other hand farming has actually improved by the withdrawal of the poor farmer, and diversified farming and labor-saving machinery on the farm have been introduced in all parts. The black prairie belt of Alabama, which was an intensive cotton center until the boll-weevil began to damage the crops, is now one of the finest dairying regions of the country, and also furnishes large quantities of vegetables, fruits, and corn to the Birmingham-Montgomery industrial section. The moderate climate of the South is also a great aid to food production and to workmen's housing conditions. The whole aspect of living for the workman is much more favorable than it is in most of the manufacturing centers of the North where the winters are severe and foodstuffs must be imported.

Atlanta has become a most important distributing center in the new industrial progress of the South. It is a railroad center that is admirably fitted for easy distribution to a large area, and in the last two years more than 300 organizations doing business on a national scale have opened branches in that city. Ten years ago cotton was the reigning factor in Georgia, but the state now produces vast quantities of corn, tobacco, peanuts, peaches, and other diversified products. The mineral development also contributed $20,000,000 to the wealth of the state last year. The mill establishments include ginning and textile plants, peanut-oil and cottonseed-oil mills, syrup plants, fertilizer plants, furniture factories, and canneries. Railroad shops are located at Atlanta, Columbus, and Macon, and an important builder of cotton machinery is located at Columbus. It is estimated that there are a little over 3,000 industrial establishments in the state with 138,000 employees. Fully $200,000,000 is invested in textile mills alone, and there are approximately 4,000,000 active spindles and 60,000 active looms in these plants, employing 60,000 white persons and 5,000 negroes. These mills are buying their machinery mainly in the North, but there are numerous contract machine shops in all of the centers, where repair work is being done and where replacement parts are being made on an increasing scale. A short article of this kind can do little more than point out a few of the underlying economic factors and the steps that are being taken to transform this great region into an organized industrial center. When it is considered that North Carolina alone is almost as large as all of New England, and that the favorable climate and extensive ideal farm land will keep this whole region self-supporting for many years to come no matter how great the concentration of industry, it can be appreciated that the section has advantages over many other localities. In addition, the natural resources in raw materials will furnish supplies for an indefinite period. Amongst these materials may be mentioned the white and yellow pine with its attendant naval stores and wood distillation products; the hardwoods of the Carolinas that supply the furniture and wood-products factories; and the iron, coal, bauxite, manganese ore, limestone, phosphate rock, and graphite. To develop these resources, and for the operation of the manufacturing plants there is a vast store of highly developed hydro-electric power.

> Congress continues to argue of possibilities at Muscle Shoals, but the big power companies of the South are going ahead in the production of other vast resources of cheap electrical energy which is giving the new industrial plants an advantage over those in many other parts of the country, and making possible development on a large scale

The spirit of progressiveness has not hit the centers of population only, but it has extended to the small farmer who has turned to diversified crops, electric power, and labor-saving machinery. The well-known quaintness of so many Southern cities is disappearing, and modern buildings, well-paved streets, and municipal works are changing the nature of the life. Each of the States now has a well organized road program, and public education is rapidly improving. It is claimed, for example, that Montgomery County has been ranked first in school standing in the United States. The port cities have been keeping pace with the development in the interior by the planning of shipping and warehousing facilities, better schedules on the connecting railroads, and by the establishment of new steamer lines.

It can be seen that there is a vigorous spirit of industrial and mechanical development already established in the South. The coming of the mills and the establishment of new chemical, metallurgical and mechanical industries on the basis of the available raw materials is already a visible fact. Behind these new manufacturing industries the machine shop must naturally follow.

Grinding Non-Metallic Materials

Photographs by courtesy of the Gardner Machine Company

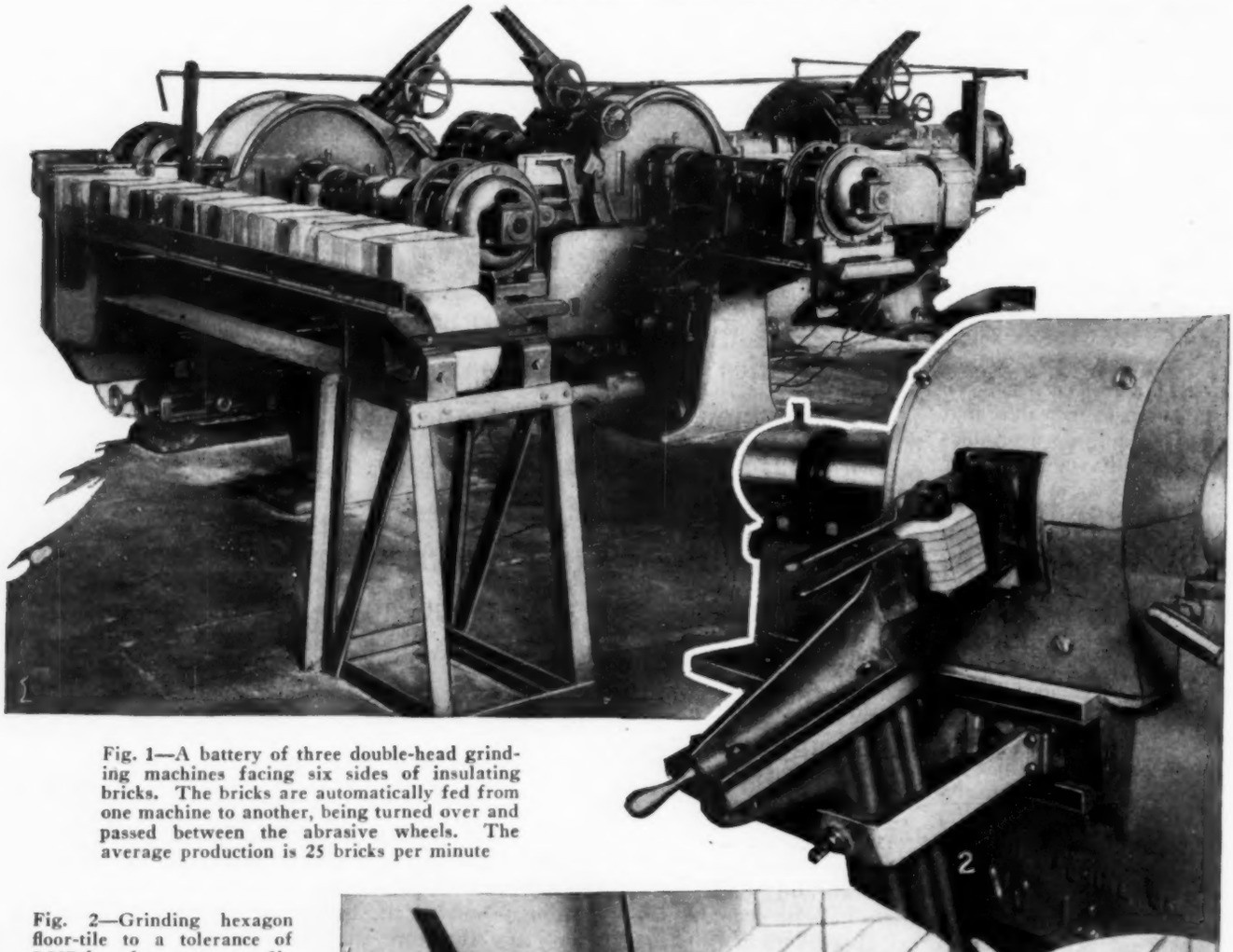


Fig. 1—A battery of three double-head grinding machines facing six sides of insulating bricks. The bricks are automatically fed from one machine to another, being turned over and passed between the abrasive wheels. The average production is 25 bricks per minute

Fig. 2—Grinding hexagon floor-tile to a tolerance of 0.007 in. of squareness. Six pieces are placed on a swinging member, being clamped and held in place by the operator while being ground. Approximately 1/32 in. of material is removed from a side, and the production is 600 pieces per hr., which includes the finishing of six sides. Two 20-in. abrasive wheels are used

Fig. 3—China syrup-jars being ground on four sides to make tight-fitting surfaces. From 1/16 to 5/64 in. of material is removed, the finished sizes being held to within 0.01 in. of squareness. The jars are held in a fixture mounted on the cross-feed slide and are carried between two 20-in. segmental abrasive wheels. The production averages 100 jars per hr., completely ground on four sides

Labor-Saving Tools from a Southern Railroad Shop

By Frank W. Curtis
Western Editor, American Machinist

Some convenient lifting and transporting devices used instead of cranes—A forging clamp for the blacksmith shop for handling heavy work

AMONG other labor-saving tools used by the Vicksburg, Miss., shops of the Yazoo and Mississippi Valley Railroad Company, are miscellaneous devices for lifting and transporting parts within the shop buildings. One of these is the portable jib crane for lifting and fitting driving boxes in place on journals as illustrated in Fig. 6. One of the features of the device is that one man can attach the crane to the axle and place the boxes on the journals in a relatively short time. The mast is made of pipe and has a V-shaped plate that fits the axle, as shown, enabling the bottom plate, also V-shaped, to be attached to it by four bolts. An ordinary chain hoist is attached to the boom, while a yoke of special design, gripping the box by the shoe and wedge faces, is used to hold the driving box. The box illustrated has no crown brass but was used merely to show the device in operation.

Another useful device is the truck-wheel lifter shown in Fig. 7. Two units are required, however, one for each end of the axle. In use, the tongue is raised sufficiently to permit the V-block to pass under the axle, then it is brought down to the normal position which raises the wheel from the floor. Inasmuch as the leverage is approximately 10 to 1, it is not necessary to exert excessive force in lifting the load. The V-block is mounted in a trunnion block, being pivoted by two shoulder screws, so that it will remain in a vertical position regardless of its relation to the tongue. A convenient form of tire sling is illustrated in Fig. 8. Three hooks are required to complete the sling, the hooks being spaced equally around the periphery of the tire to be raised. Each hook is made of two forgings, as detailed at the left, one forging being flat, having a straight face that fits the inside of the tire and an eye for connecting the chain, while the other one is forked at one end for a joint and is formed at the opposite end to fit the flange of the tire. Once the hooks have been placed on the tire, the tendency is for them to tighten when lifting force is applied.

Those familiar with blacksmith-shop work know the trouble caused by forging tongs working loose, especially when holding a large bar or billet. To eliminate the trouble from loose tongs, the clamp shown in Fig. 9 is used. It is forged from steel and resembles a large open-end wrench. In Fig. 10 is shown a close-up view of the clamp attached to a forging. The foregoing enters the open end of the clamp and is held securely by a tapered wedge, the flat side of the wedge striking the face of the work and the angular edge fitting a groove in the clamp body. This form of grip seldom works loose. Another feature of the clamp is the cross handle fitted in the central portion of the projecting end, and used in rotating the work under the hammer. Although this type of clamp is not used exclusively, it is carried in many sizes. The clamp is attached to the work and is allowed to remain in place during the heating operation and until one end of the work has been forged.

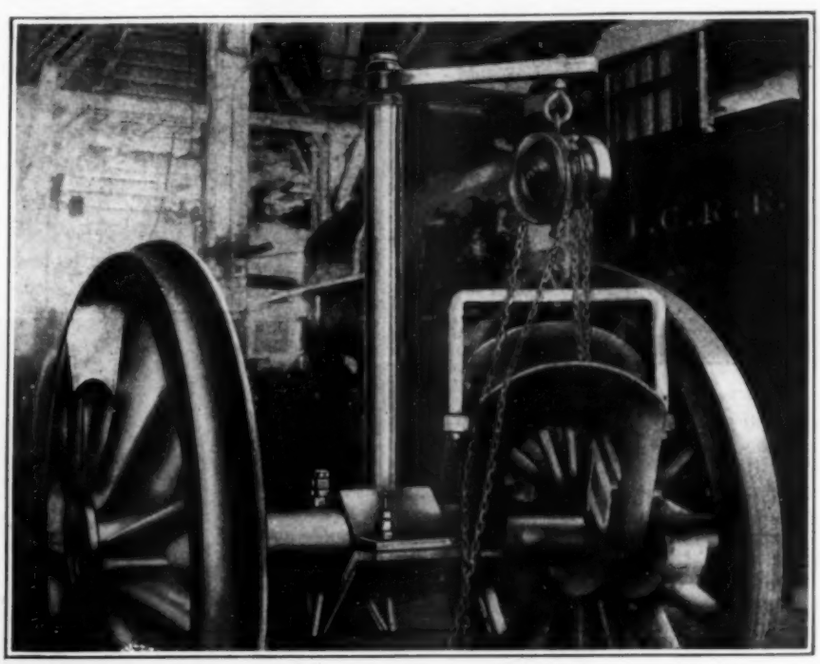


Fig. 6—Portable crane is attached to a driving axle and used in fitting driving boxes to their journals. The boom is equipped with a thrust bearing. One man can handle the operation in a comparatively short time

Conclusion of the article.

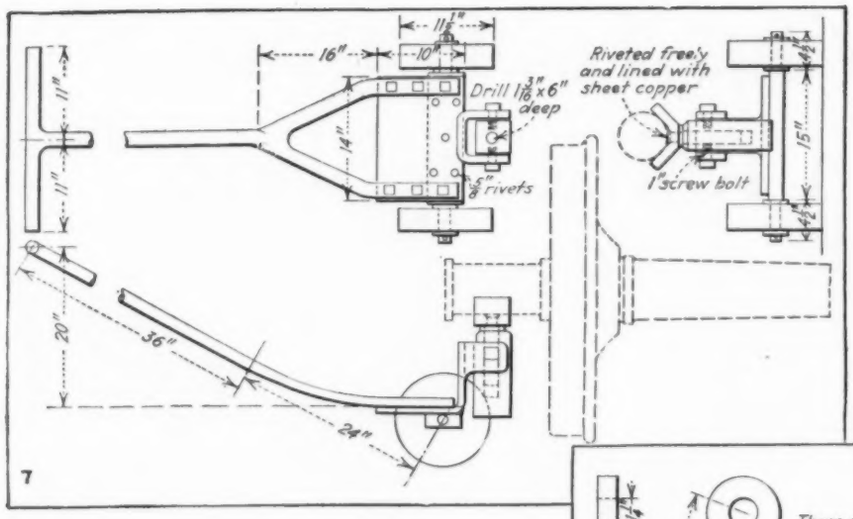


Fig. 7—By using two of these lifters, truck wheels can be moved or shifted around the shop without difficulty. The ratio of leverage is 10 to 1. The V-block is mounted on a trunnion so that it will remain in a vertical position regardless of the position of the tongue

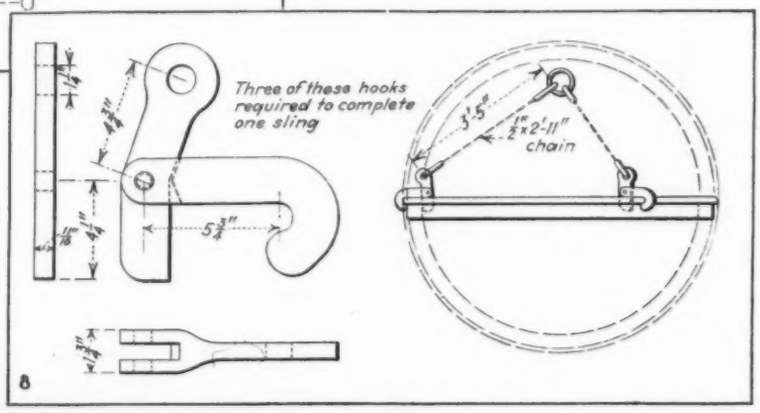


Fig. 8—A tire sling with three self-gripping hooks. Each hook is made in two sections, forged from 3/4 x 7/8-in. steel. One section is flat, while the other is forked at one end and formed at the opposite end to fit the flange of the tire

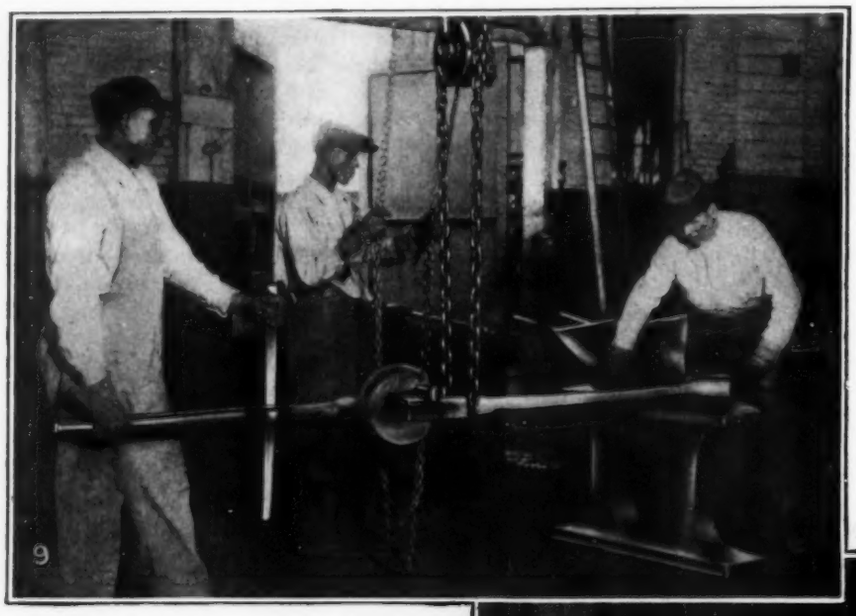


Fig. 9—Forging clamp for heavy work. The clamp is made of forged steel and resembles an open-end wrench. In use, it is attached to a bar or billet and remains in place during the heating and until one end of the work has been completed

Fig. 10—Near view of the forging clamp, showing how the work is gripped by a tapered wedge. One side of the wedge bears against the work while the other fits an angular notch in the clamp which prevents it from shifting out of place. A cross-handle in the end facilitates turning of the work during forging

THE · FOREMAN'S · ROUND · TABLE

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

Getting the Wear Out of Machines

"SEEMS to me, Al, that Williams is a bit short-sighted to crowd those new machines so hard. That new steel sure stands punishment, but it's mighty hard on the machines."

"Hasn't caused any breakdowns or idle time, has it, Ed?"

"Not yet. But it's bound to wear them out faster than if he ran them at the old speed. Those machines cost good money, and they are surely being pushed to the limit."

"Don't you worry, Ed. Williams knows his business. He wouldn't be pushing them unless he knew it was safe to do so."

"But they'll wear out quicker, Al. He doesn't want that, does he?"

"Of course they will, and I suspect that's just what he does want."

"That's beyond me, Al. Don't see why anyone wants to wear machines out so they'll have to buy new ones."

"Try and look at it this way, Ed. Just suppose that lathe could cut only fifty tons of metal chips before it was worn out. If you took light cuts you could spread its life over ten years—perhaps more. Don't you see it would pay you to get this amount of work out of the machine at the earliest possible moment?"

"Can't say as I do, Al. I don't want to wear out any car that way."

"Not the same at all, Ed. Your car isn't a business proposition. But if you got paid by the mile, then it would pay you to run it as many miles a day as you could. The sooner Williams gets the work out of the machines, the better. He's got his money back, and he can replace with a better machine that will earn him more money."

"But what about breakdowns from abuse, Al?"

"That's a different story, Ed. I was talking about wearing it out, not about breaking it up. Of course, there's a point when it's a waste to run it harder. But with the rapid changes in machine tools these days, the sooner you get the work out of them, and get new ones, the better. Williams would rather wear them out than to nurse them along, and then have to scrap them before he's got all the work he could out of them."

"Maybe you're right, Al. But it's a new slant to me. I've had the notion we should make machines last as long as we could."

Is Al right as to Williams' idea of higher speed? Or, is Ed right in giving wear first consideration? What about Al's idea of wearing machines out rapidly?

All foremen are urged to discuss these questions vital to their work; of course the

discussion is not limited to foremen. Letters accepted and published will be paid for

Discussion of Earlier Topics

Extra Pay for Extra Effort

A NOVEL method of reimbursing an operative for his ingenuity was employed at a very large plant in the East. A milling machine operator was given a difficult job. The work had been studied by all foremen concerned, and a piece-rate had been finally decided upon. The operative soon designed, on his own time, a fixture whereby he could produce the work in a little less than half the time. The job was consequently finished in a couple of weeks, but we knew that it would probably result in a repeat order. Since then the order has been repeated about every four months regularly.

Was this operative paid a bonus? No, that would have been forgotten among the employees in a few weeks. His reward came in the privilege of being assigned this particular operation on every new order. The result is a big pay envelope for him for two weeks every four months. A more effective reminder that extra effort is appreciated and rewarded could not have been devised.

—W. S. BROBERG, *Lieut. Ord. Dept.*

ANY change in method or tooling involving a change in the required time to do a job justifies a change in rate. The fact that such improvement was suggested by the operator affected by the change in rate is of no significance. He should be rewarded for his improvement, but not by retention of a rate that is not a fairly accurate measure of the time element. It is assumed, of course, that the change in rate will not decrease the operator's earning, but reflect the increase in production procurable by means of the improvement. Also, the new rate should provide an incentive for the expenditure of extra effort. —V. S. SWAUGER.

Too Many Safety Signs

UNQUESTIONABLY too many safety signs, will have the opposite effect of that for which they were intended. Like all good things, however, there is a tendency to let enthusiasm overbalance good judgment, hence the tendency toward quantity. It does not appear reasonable, in this case, to refuse to put up new signs, if they were to replace the old. In fact, I would rather favor the new, inasmuch as after a certain length of time, the old signs might just as well be taken down for all the effect they have. A new sign will always attract.

I would like to add a word to the kind, or quality of some of the signs. Sometime back, I noticed one that had a brick bounding at right angles and striking a man. Perhaps some signs are made ridiculous to convey their meaning, but it should be remembered that they are for the scrutiny of supposedly sane-minded people. A little more attention to detail might help improve them.

—WALTER W. YAEGER.

WE HAVE a method of reminding our employees to be careful, which works out nicely, and does not become monotonous. Each department has its bulletin board in a conspicuous place, and room is provided for the regular National Safety Council bulletins. About once a month we get a new series of bulletins which are sorted to suit the individual departments. These bulletins are all tacked on the proper board, one over the other, and every few days one is torn off leaving the next one exposed. It is surprising to note how much attention each new poster draws. —C. L. NADON.

IT IS my opinion that Williams is to a large extent correct in not allowing the posting of an excessive number of signs. It has been my experience, however, that a few well-selected signs changed at frequent intervals are very valuable in developing what is termed "safety consciousness" in industrial employees.

Posting signs giving safety slogans only, however catchy, is of doubtful value. A picture has a universal appeal, and is much more likely to leave a lasting impression. —N. H. WARDALE.

Paying a Bonus to Outsiders

IT HAS been a practice in my shop to reward the man making a worth-while suggestion with a flat gift of one, five, ten, fifteen or up to one hundred dollars, according to the decision of a group of foremen and production managers as to its worth to us. If the man is on a weekly salary, he is rewarded with a raise and is usually told in a business-like way that we appreciate the fact that he is using his head. On the other hand, if he is a man doing piecework we give him a better job,

THE · NEXT · TOPIC

Promoting Interest Among the Boys

ADVANCE QUESTION

Al has been reading and hearing about the bad effects due to lack of interest on the part of men in the shop. It's a common complaint in many quarters. Al feels that the best place to begin may be with the boys, and he's planning a little party for them. How do you feel about it?

if he is able to do it, or at least give him a trial and also a bonus. It is understood that none of these rewards are to be given until the suggestion has been applied and is actually giving results. —C. H. WILLEY.

IF A MAN on productive labor performs his own task to the management's entire satisfaction and still finds time, whether during or after working hours, to indulge in some thinking which results in increased production, elimination of operations, fewer parts, or anything else of vital interest to the company, even if the improvement concerns other work than his own, he is a valuable man and should be encouraged. However, if he neglects his own work while pondering on better methods, he deserves no bonus. —R. E. PETERSON.

WHETHER the improvement is suggested by the man on the job or one not on that particular job is immaterial. The only point is to find the proper man to reward for any worth-while suggestion. It must be borne in mind that the self-styled "efficiency expert" cannot be permitted to wander about the shop looking for opportunities to improve things at the expense of his own job. That is a problem in discipline, and if necessary such a man should be fired or penalized for not attending to his job. —W. T. VAN HORN.

Training the Foreman in Management

A COURSE in management problems is something the average foreman should eagerly seek to obtain. Probably the average does, but somehow, here or there, because of some attitude hastily assumed when foreman training was in its infancy, there is an individual who still persists in laughing at it and, who will have no part of it for himself.

But you cannot leave him out, for his very position shows that his is an impressionistic mind, which hangs tenaciously to its first impressions. If he is not made to attend the classes provided, he is certain to see advancement of his fellow foremen, not as a consequence of their awakened consciousness of managements problems and their after solutions based on it, but rather as a matter of rank favoritism because they went to school like good boys. As he is otherwise a good man, there is only one solution possible, which is that of making him help himself by means of compulsory attendance. Eventually such a man becomes an enthusiastic supporter. —MORTON SCHAM.

Shall It Be Layoffs or Short Time?

WHENEVER there is a lull in business, I firmly believe the best practice is to operate on a short-time basis in order to give as many employees as possible a chance to earn part of their living. In some cases, it may be necessary to keep a few of the very best employees on full time.

But it would be a mistake to allow the men to vote on this question. I suggest that the person in charge discuss it with employees, simply feeling them out and getting their opinions on the question. A factory properly managed will have no difficulties with employees when a question of this kind is put to them. What I would do in my department would be to call a meeting and explain the situation. I would get their general opinion, and then act. —PAUL LINDER.

IN THE matter of deciding between a layoff for some or short time for all, I am sure Ed will find that the old-timers, even though they may feel that their jobs are secure, will in most cases vote with the rest for short time. The average worker is never in such a good position that he cannot put himself in the place of the man who has lost his job.

It seems to me that in a case like this where the choice means so much to the men, the best plan from the standpoint of good management would be to let the men decide. The management should, however, explain just what the plan is, and what either choice will mean to the management as well as to the men.

—C. H. LATTNER.

IN THE case of a temporary depression it is usually advantageous to keep the whole force together and work short hours. Therefore it would be inadvisable to put the question up to the men unless it was reasonably certain that they would vote favorably.

As far as the betterment of plant morale is concerned, there is a very distinct benefit to the company in giving the men something to say regarding questions of mutual concern. It might be advisable for the management to allow the vote of the men to decide certain questions even when the result is liable to be unfavorable to the plant. This disadvantage may be more than offset by the benefits resulting from the increased good will of the employees. —W. L. ROMICK.

Should the Super Talk to the Men?

THERE is no good reason why he should not do so provided he does not issue orders over the head of the foreman. There is one exception to this in that he may tell a man to stop work on a job if it is important that the job should not continue and the foreman is not at hand. The super may know of a change to be made or that the job is wrong for some other cause. However, the extent of the order should be "stop work on that job until the foreman gives you further instructions. If the super goes about the shop issuing orders against those of the foreman, shop discipline will suffer, and production will be lowered."

In conversation with the men, the super will be able to learn much of their views of the work and will be able to locate suitable men as foremen or assistants for other departments of the plant. It is better for the super to have his own opinion of a man as well as that of the foreman when choosing a man for promotion. If a man is to have promotion, it is certainly better for both he and the super to be personally acquainted.

There is one thing that the super should not do in the absence of the foreman and that is to encourage complaints. These should always come through the foreman, and should preferably be written since a written complaint always seems easier to settle.

—ALBERT GUYLER, *England.*

Large Hydraulic Turbine

The pictures on these pages illustrate work that
and heaviest class which must be sufficiently

Photographs by courtesy of the Dominion

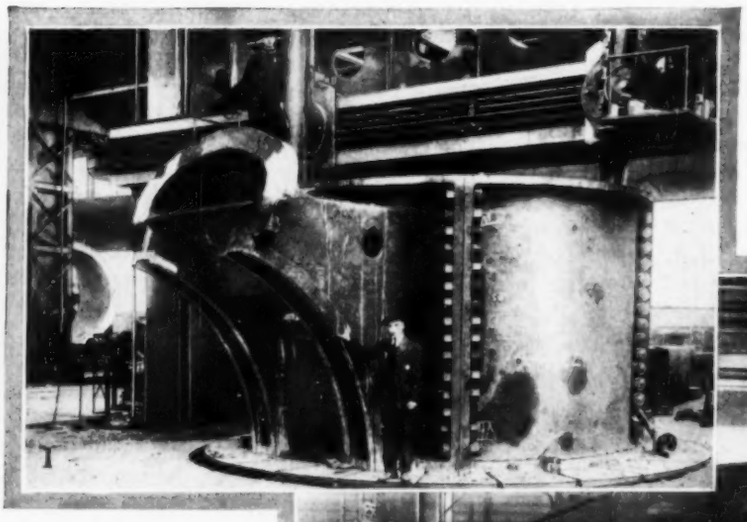


Fig. 1—A section of a 41,000-hp. turbine casing being machined on a 35 ft. Sellers vertical boring mill. This mill is one of the largest ever constructed in North America. The clearance between housings is 35 ft. 3 in. and under the tool holder it is 18 ft. 6 in. The table is 20 ft. in diameter and has a total load capacity of 450,000 pounds

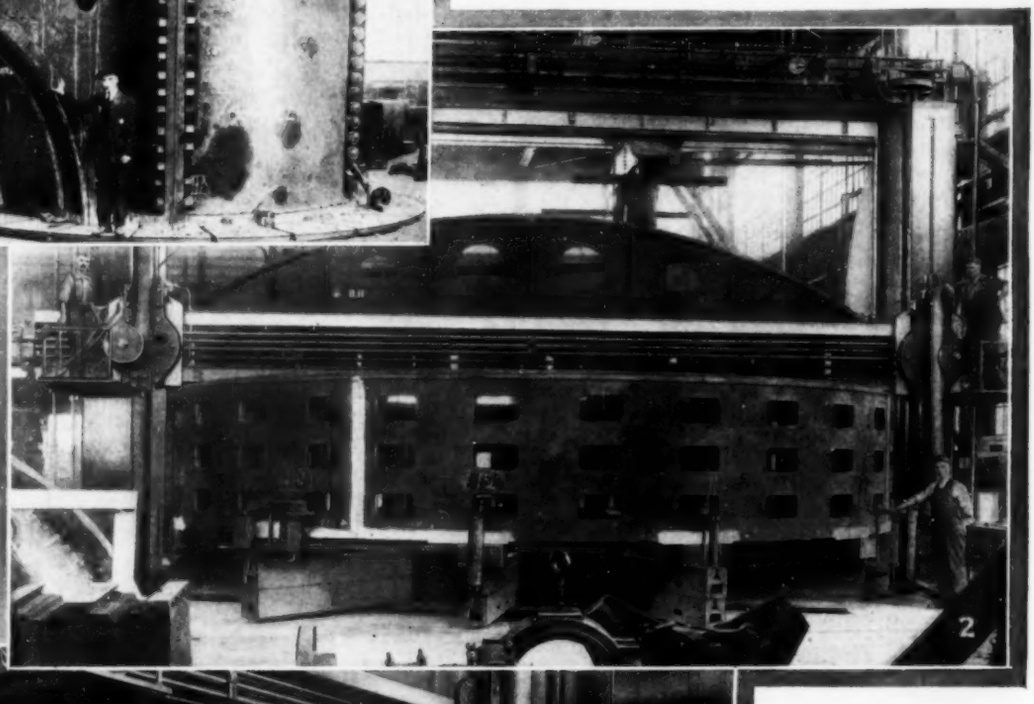


Fig. 2 — Boring the stator ring for a 41,000-hp. turbine on the same boring mill. The boring mill rams are made of steel and have a movement of 84 in. They are counterbalanced on the inside

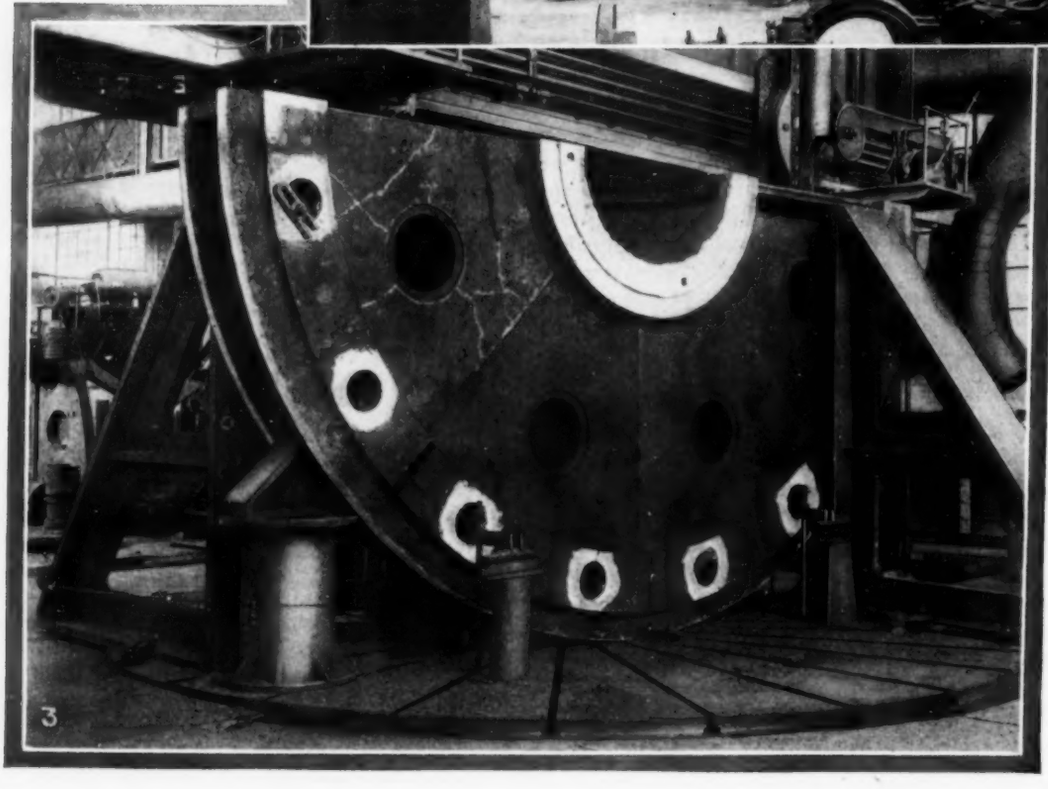


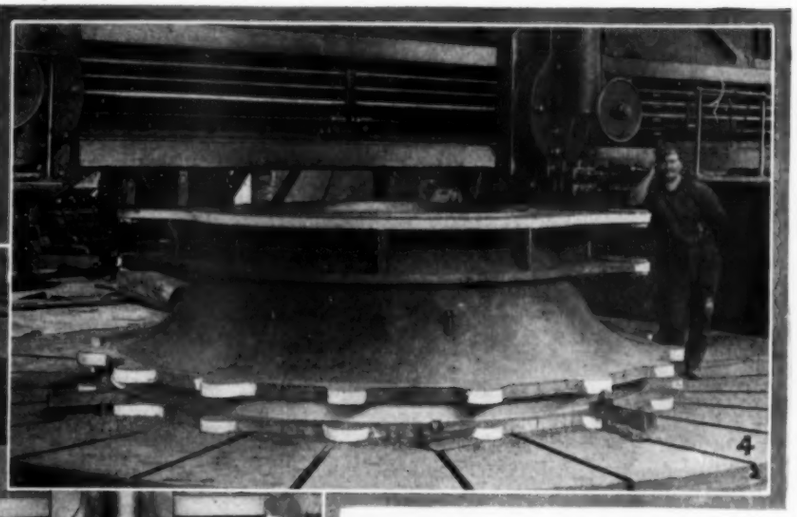
Fig. 3 — Facing the joint on half of the cast-iron head cover for a 28,000-hp. turbine. Although this job is normally one for the planer, it was found easier to machine it on the boring mill, holding it with the large angles that align it and take the cutting thrust

Work in a Canadian Shop

can be done only on machine tools of the largest rigid to support heavy castings of large diameter

Engineering Works, Ltd., Montreal, Canada.

Fig. 4—A cast-iron turbine operating ring being machined on a large boring mill. This ring is for the same 28,000-hp. turbine and has already been faced and had the grooves turned on the other side



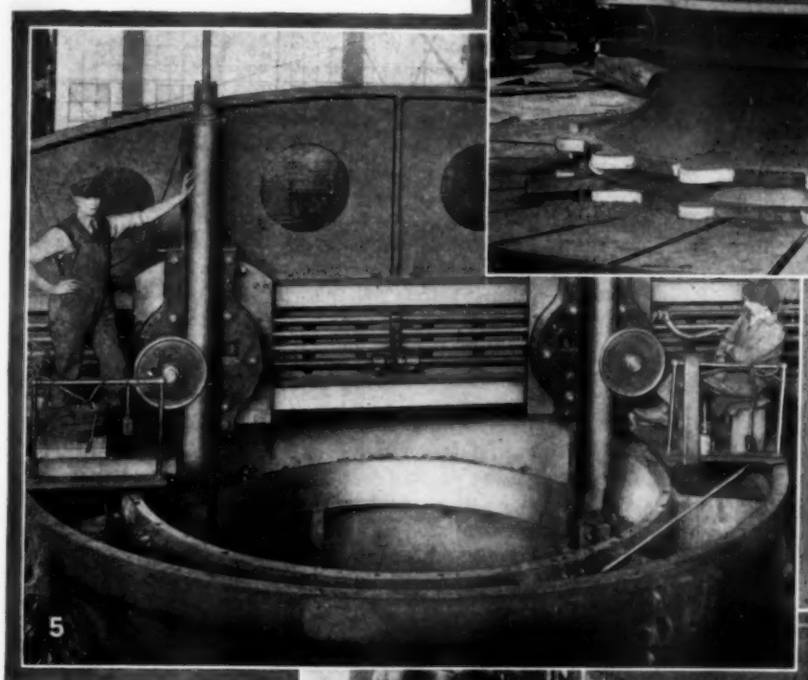
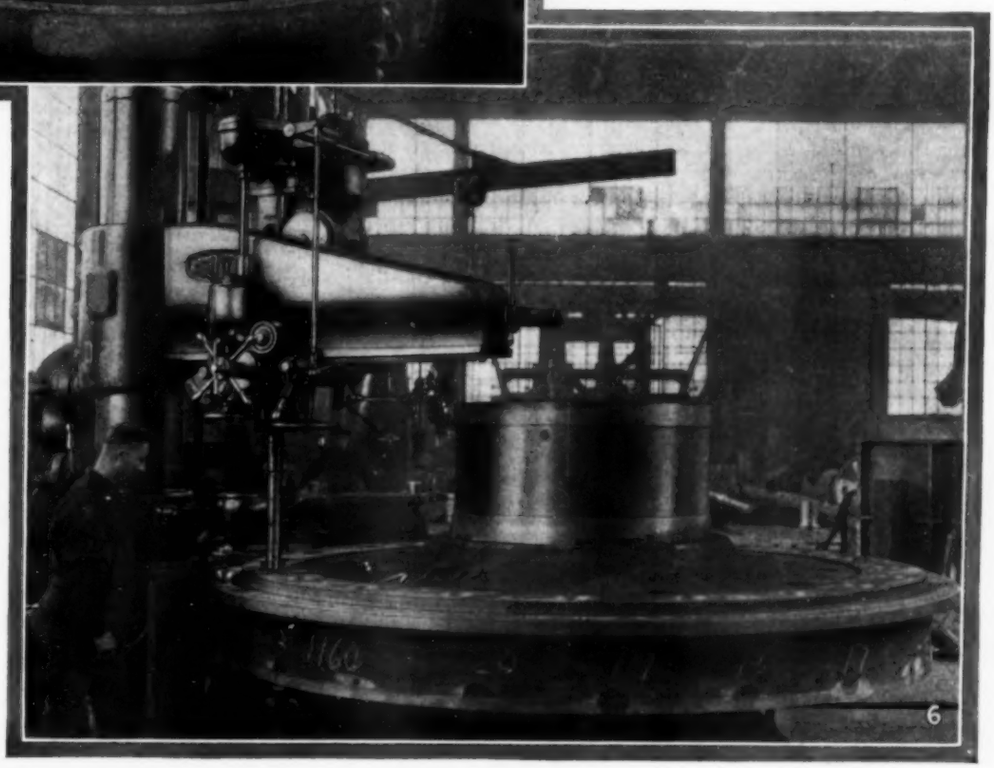


Fig. 5—Machining the upper part of a 193-in. Johnson valve. Both tools are at work and a man is required to operate each tool ram and head. The valve is a steel casting

Fig. 6 — Boring guide-valve holes in the head cover of 6,000-hp. turbine. The boring bar is driven by a 5-ft. Asquith radial drilling machine and the work is indexed from one position to the next. The bar carries both boring and facing cutters



· BOOK · REVIEWS ·

How to Get the Most Out of Business. By B. C. Forbes. Two hundred forty-eight, 5x7½-in. pages. Imitation leather binding. Published by the B. C. Forbes Publishing Company, 120 Fifth Ave., New York, N. Y. Price $2.50.

THIS is a book that can be read with profit by every executive. It is a departure from the stock book on business both in its form and in the text. The author of the book apparently knows what the American business man needs from his intimate contact with the bigger men of affairs as publisher of Forbes magazine. It is a guide to business success, but decidedly not a guide to money making.

In the book the author has set down a number of chapters unrelated in detail, but very pertinent to his general subject. He starts out with the assumption that the triangle of business, family, and health enters every man's life, and that the so-called successful business man too often neglects the last two of these. He also takes up pointedly the successful business man's duties to his employees. The chapters are varied enough in style and subject to be continuously interesting, or each one is complete in itself. They draw illustrations from live experiences of the present-day world of industry, commerce, and finance. The book can be considered as an important contribution towards the goal of humanizing business.

Bibliography on Mechanical Springs. A.S.M.E. Research publication. Subjects indexed, 71 pages, 8x10½ in., paper covers. Published by the American Society of Mechanical Engineers, 29 West 39th St., New York.

THE Special Research Committee on Mechanical Springs of the American Society of Mechanical Engineers has prepared this comprehensive bibliography on mechanical springs in line with its policy of determining the present status of the mechanical spring art and of promoting and conducting the necessary research. A very exhaustive study of the 600 or more references contained was made for the purpose of drawing up a thorough digest. The articles are indexed according to authors, and also chronologically. Definitions of the various types of springs are included, as well as the history of the development of the art.

How to Understand Accounting. By Howard C. Greer, C.P.A., Professor of Accounting, Ohio State University, Director of Accounting, American Institute of Meat Packers. Two hundred and fifty-five pages 6x9 inches. Illustrated by charts and diagrams. Cloth boards. Published by the Ronald Press Company, 15 East 26th St., New York City. Price $3.

AS STATED in the foreword this text is entirely non-technical. Its purpose is to treat accounting principles from the standpoint of the executive who should understand them, without going into all the details of procedure that make up the technique of accounting and bookkeeping in full detail as it is now practiced. It is no short cut to a full grasp of the whole accounting problem. That can come only after careful study. It does build up, however, an outline that will give the executive all he needs to know about the functions of business records.

The book is not intended as an elementary text for beginners in accounting. A glance at the contents shows that the scope is far more inclusive. The style is easy and the policy of including simple examples to illustrate the various principles as they are set up is helpful.

The chapter headings give the best picture of the material covered. They are: Nature and scope of accounting; The double-entry principle; The mechanics of bookkeeping; Classification of accounts; Perpetual inventories and cost accounting; Determining and recording profits; The problem of valuation; Statements of financial position; Statements of operating results; Analytical and comparative statements; Budgetary control; Auditing and internal check.

A.I.E.E. Yearbook—1928. Five hundred and ninety-eight pages, 6x9 in., cloth boards. Published by the American Institute of Electrical Engineers, 33 West 39th St., New York, N. Y.

THE primary purpose of this book, issued annually, is to publish an alphabetical and geographical list of the membership of the Institute. A list of local sections is given, while a list of institutions where student chapters are maintained is appended.

General information concerning the Institute, the constitution, the by-laws and resolutions, and a report of the board of directors constitute a good portion of the book. Considerable information is presented which deals not only with the present status of the activities of the society, but reviews the progress made in previous years. The steady growth of the membership is shown by an interesting graph.

Code for Design of Transmission Shafting. Prepared by the Sectional Committee on the Standardization of Shafting of the A.S.M.E. Twenty-two 10½x8-in. pages, 2 charts, 1 graph, paper cover. Published by the American Society of Mechanical engineers, 29 West 39th St., New York, N. Y. Price 75 cents.

THIS Tentative American Standard is the result of a thorough study of the basic concepts upon which the formulas for the design of transmission shafting are founded. The code produced covers formulas for the cases most frequently met with in practice and offers diagrams for the solution of problems as a further aid. The only limitation imposed is that the formulas provide only for the strength of shafting and not for rigidity or deformation.

Appendix A covers the various stress conditions that may be set up in a transmission shaft; the various theories of elastic failure evolved from time to time, leading to the many formulas found in engineering literature; the application and limitations of the various theories of elastic failure as applied to ductile ferrous material used in shafts and the elastic shearing strength of ductile ferrous materials.

Appendix B covers designing stresses, shafting steels, effect of straining action upon working stresses, and the use of constant or base stress with shock and fatigue factors. Diagrams assist in the solution of problems.

Research Results in the Telephone Industry

By Philip Chapin Jones
Bell Telephone Laboratories

Self-starting research and development have saved the various companies included in the Bell telephone system many millions of dollars

INDUSTRIAL research has been growing apace as a realization of its worth has become more and more apparent to the managements of the larger industries. In general its adoption has been for admittedly selfish reasons. This is an age of rapid progress and if a manufacturing concern is to maintain or improve its relative standing it must forever be making improvements to its product. Consider for example the automobile industry. If one manufacturer brings out a new model with distinct improvements all the other makers of the same grade of car must also bring out improvements or their sales will fall off.

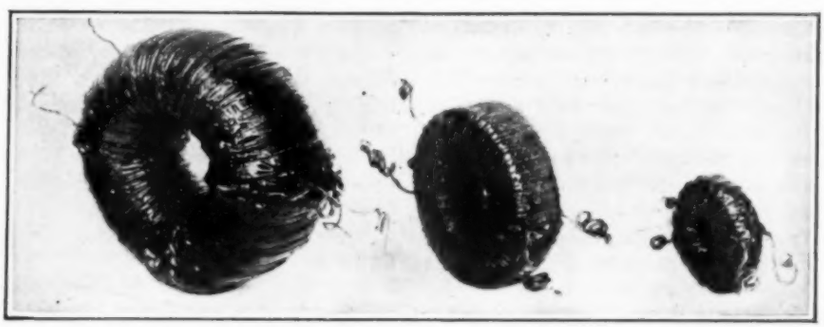
In the automobile industry the studies necessary to bring out improvements ordinarily go under the name of development work rather than of research; but development work and research are essentially alike in motive. Research deals more with fundamental facts previously unknown, and development work with arrangements and utilizations previously unused; but in other respects they are much alike and at least in their industrial applications may be considered together.

The telephone industry owes its existence to research, and so has naturally recognized its value from the beginning. Bell Telephone Laboratories, doing research and development work for the American Telephone and Telegraph Company and the Western Electric Company, has a personnel of nearly four thousand at the present time, half of whom are scientists and engineers. There has never been any doubt that this pioneering work has paid for itself many fold. The savings from a half dozen capital achievements would be sufficient to create a fund that would support all telephone research work for the rest of history. The telephone was born of a pioneer family at one of the outposts of science. Only the telegraph had preceded it into the then unknown realm of electrical transmission and its path lay so far to one side of the trail which was to be followed by the telephone that little help could be obtained from it. The transmission of voice currents is a phenomenon distinctly different from the transmission of interrupted direct current impulses, such as the telegraph, and required the development of both a theory and practice of transmission. Also the large number of telephones which soon came to be used in areas of relatively short radius required the development of a technique of dealing with very large numbers of wires in very limited spaces. The development of fine wire cable is the result of efforts in this direction.

Early telephone circuits were all of open wire on poles until the streets became canopied. To put them under ground was the problem. Research studies and experimentation, followed by more research and more experiments, kept the engineers and scientists busy.

There was almost no end to the types of cable tried but from the throng of efforts a cable with paper for insulation and lead for the protecting sheath gradually pushed to the front. Once the type of cable was fairly settled, efforts were concentrated on the problem of increasing the number of conductors that could be contained in a single covering. Cables of fifty pairs of wires grew into those of a hundred and these in turn into others of two hundred. Further development and cables of four hundred pairs, followed by those of six hundred pairs, came into use. A dozen years ago cables with twelve hundred pairs of wires inside a lead sheath only two and five-eighths inches in diameter became a practical reality.

With each increase in the number of wires in a cable came a decrease in the cost per wire per mile. A mile of circuit (two wires) of the early fifty-pair cable cost about one hundred fifty-five dollars while the corresponding figure for the twelve-hundred-pair cable was only about twelve dollars and a half. These figures are installed cost including the cost of the duct so that they reflect the greater economy of space as more and smaller conductors are crowded within a single lead sheath. The savings in investment in just the change from six-hundred-pair cable to the twelve-hundred-pair were



How research and development have reduced the size of the loading coil in a score of years. At the same time cost reductions have netted two million dollars in savings and efficiency has increased considerably

© Bell Telephone Laboratories

great enough to earn annually over three and a half million dollars for the Associated Companies of the Bell System. Development work has now progressed to the point where we may predict a cable of eighteen hundred pairs of wires in the very near future.

Along with this cable development came developments in transmission over long distances. Space cannot be taken to even suggest the numerous obstacles that had to be overcome. Loading was adopted shortly after 1900. Intensive search for better magnetic materials followed. Coils with iron wire cores gave way to those using powdered iron and recently these have been replaced by coils with cores of powdered permalloy—the new magnetic material developed by Bell Telephone Laboratories. It has been estimated that two million dollars a year is being saved by this latest combination of development and research.

Repeaters that pick up telephone currents weakened by traveling long distances over wires and send them on their way with renewed strength, although in use for only a decade, now number nearly twenty thousand in the American long-distance telephone system. In the early days the size of the wires used had to be increased as the distances lengthened out. Number eight wire—about an eighth of an inch in diameter—had to be used for the longer lines. The twelve-hundred-pair cable uses wires a little over a sixty-fourth of an inch in diameter (No. 24 gage) and over them telephone conversations can be carried on by the aid of repeaters even more satisfactorily than was possible before with the larger wires. Savings credited to repeaters run over twenty-five million dollars a year, and as a result toll rates have been reduced twice within the last two years.

Research Not Stimulated by Competition

It is of interest that this research and development work of the Bell System is not, for the most part, stimulated by competition or a desire for extra profits as is most industrial research. The Bell System is essentially and necessarily a monopoly and its announced policy is to distribute no more than normal and regular dividends. Its research and development work is undertaken for the improvement of the industry of which it is the Godfather and so may well serve as an example for all industrial research both because of its value to the industry and because of its motives. Professor Cabot of the Harvard Business School recently said, referring to the Bell System: "The thing is a modern miracle which I can only explain to myself by assuming that the men who conceived, created and have developed the telephone were men of the rare automotive type whose driving power came from within, and who, therefore, did not need the external stimulation which competition alone can give."

Not only does industrial research prove decidedly worth while to the particular industry supporting it, but to the world at large. Investigations along any one line are continually unearthing new facts that have extensive general application. From these, new developments spring which contribute not inconsiderably to the general welfare. The development of such things as the public address system, the improved phonograph, the vitaphone, and television by the research organizations of the American Telephone and Telegraph Company well illustrates this surplus yield of industrial research.

What will eventually become of such developments it is impossible to say. Their exploitation has been entrusted to others and will undoubtedly result ultimately in public benefits.

SEEN · AND · HEARD

By John R. Godfrey

Watching the policeman sleep
Shop secrecy

FIRST impressions are often far from right, but it usually takes quite a while to overcome them when they are unfavorable. And many managers fail to appreciate how they affect prospective customers visiting their plants.

I bumped into a case the other day that was about the worst I've ever seen. The outer office of an old and well established concern was dull and dingy and had but two occupants—a superannuated watchman and a policeman,

probably private, but with uniform, club, revolver and a belt full of cartridges, the same as the regular city force. The watchman was busy sorting circulars and the policeman was slouched in a chair—asleep. There were no other chairs, not even a box on which the caller could sit. After a while the watchman got around to telephoning the man I wanted to see and in about fifteen minutes he appeared. In the meantime the policeman slept while I was standing—and mentally comparing the place with that of concerns who are alive to first impressions on visitors.

It would be interesting to know how many orders have been lost by this manner of receiving callers at the plant.

* * * *

It is sort of funny the way people cling to ideas of secrecy in a manufactured product. They don't want their competitors to know what they are doing—or how. Yet they know that if any competitor really wants to know the details of their new machine, he can buy one, indirectly perhaps, and pull it apart to see how it works.

Furthermore that's exactly what they do—I've seen many a machine pulled apart in the other fellow's shop—and there's nothing underhanded about it either. No reason why they shouldn't know. The automobile builders go so far as to exchange patent rights in most things.

Yet a lot of men who know all this, who even buy the other fellow's machine and dissect it, balk at showing any of their methods in print. They can't get their thoughts away from the few competitors who already know all about them.

I've seen methods that were supposed to be shop secrets used in shops a thousand miles apart, each supposing that no one else had ever heard of that way of handling work. One reason for the success of the automobile builders is that they haven't had shop secrets.

Apprenticeship in Dull Times

Maintaining the Institution

By C. J. FREUND

Apprentice Supervisor, The Falk Corporation

MERELY organizing an apprentice department does not completely solve the apprentice problem. The institution must be constantly developed and strengthened or it will gradually weaken and die. Dull times are advantageous for undertaking a program of apprentice training. They also provide an excellent opportunity for reinforcing the foundations of the enterprise and confirming the status which it has attained in the plant and in the community. There is probably no single factor that plays such an important part in successful training work as confidence and loyalty on the part of apprentices and their parents or guardians—confidence in the determination of the employer to provide adequate instruction and in his ability to see the boy through to the completion of his contract regardless of circumstances; loyalty because of thought and effort devoted to the well-being of his apprentices. Loyalty is necessary for success in every industrial undertaking. Confidence is particularly necessary in apprenticeship because there are so many things in an apprentice training program which do not immediately appeal to the apprentice as beneficial. Many apprentices do not easily see the advantage of school work. On first consideration this may be surprising, but the fact remains that every corporation that has ever attempted the training of mechanics has probably found apprentices with extraordinary mechanical ability who strenuously objected to shop mathematics, blueprint reading and other subjects. Also, the average apprentice becomes impatient with any operation after he has attained a certain fundamental skill in it. There is nothing to do except to tell the apprentice that a good mechanic requires a very considerable amount of theoretical knowledge and that only the constant repetition of an operation until it becomes a subconscious habit will impart that skill which can be absolutely depended upon in later years. Unless the apprentice has confidence in his employer he will believe nothing of this information regardless of how often and how emphatically he may be told. These are merely two illustrations of the extent to which confidence in the employer enters into successful apprenticeship. A great many more could be cited.

"There is probably no single factor which plays such an important part in successful training work as confidence and loyalty on the part of apprentices and their parents or guardians—confidence in the determination of the employer to provide adequate instruction and in his ability to see the boy through to the completion of his contract; loyalty because of thought and effort devoted to the well-being of his apprentices."

It is not easy to build up the confidence of a group of apprentices or, for that matter, of any group of people. The apprentice does not begin work easily. Especially if the parents are not well to do, it is a difficult matter to decide between apprentice training at comparatively low wages for the sake of somewhat obscure advantages in the future and a regular job at common or semi-skilled labor which will immediately have a favorable effect upon the family finances. It is difficult for ordinary people to appreciate the long-distance advantage of learning a trade. Even after the contract has been signed and the work begun, serious doubts frequently enter the minds of the young man and his parents. It may be that friends and former schoolmates of the apprentice have taken piecework jobs in industry and earn excellent wages. They have money to spend, they dress well, own automobiles and are able to enjoy entertainments and amusements which are beyond the means of the apprentice. Perhaps these friends even ridicule the apprentice for wasting his time in acquiring mechanical skill when they consider themselves to be excellent demonstrations that it is possible to get on in the world without a trade. Every apprentice supervisor must face and solve this problem not once, but often; perhaps as many times as there are apprentices in his charge. And unless the apprentices have confidence in him and in the corporation which he represents he will not be able to solve the problem in most instances.

Provided the employer is taking his apprentice training program seriously and does not look upon it merely as a fair weather diversion, a period of dull business activity provides a splendid opportunity for building up the confidence of apprentices. This does not mean that such confidences cannot be developed at other times; it means merely that it grows most rapidly when the work is slack.

The smart, piece-worker friends of the apprentice are usually but a short time out of school and are, accordingly, among the youngest employees in the production shops in which they are employed. Naturally, they are the most inexperienced and the first to be laid off and it is usually but a month or two after the first signs of

The second of two articles. The first was published in the current volume, page 569.

restricted activity that these young men are looking for work. It is unlikely that they have saved money and in a very short time they must put aside their airs of assurance and patronage. They no longer frequent the neighborhood dancing places and their cars are sold for whatever price they will bring. They are now willing to work at any kind of a job, if only they could find one, and great numbers of them even apply for the apprentice training which they formerly ridiculed.

In the meantime the apprentice and his parents may have become apprehensive. The family has probably had unpleasant experiences in the past during periods of depression. In their minds business depressions means layoffs and, regardless of promises made when the contract was signed, they begin to wonder how long it will be before the apprentice comes home discouraged with his overalls and his tools. As time passes and the apprentice continues at work in spite of restricted activity in the plant, they begin to entertain faint hopes that he will be continually employed.

Reassuring the Apprentice

The apprentice may be encouraged to inquire of his supervisor or foreman regarding the possibility of work throughout the dull period, and when he does so the employer has the supreme opportunity to win him, his parents, friends, former teachers and others once and for all. In a hearty manner the apprentice is assured that the corporation intends to live up to the contract as long as there is a wheel turning in the shop; that it proposes to carry on the work of apprentice training permanently and not merely in prosperity; that it considers the apprentice privileged in a sense because of his comparatively low wages and other features of the program; and that though hours may be reduced no apprentice will be laid off. The effect is electrical. The anxiety of the boy and his parents is dispelled, confidence in the corporation is instantly and fully established, and the apprentice feels as secure in the value of his work as he ever felt in his school days. His confidence in his employer is very much increased by the contrast between the present status of his young friends who are frantically seeking employment and their former condition of superficial prosperity which led them to belittle the purpose of the apprentice in learning a trade.

It has already been pointed out that successful apprenticeship is largely a matter of community contacts and community support and approval. No industry can train apprentices effectively if the public does not believe in the system. Too many people remember the abuses which destroyed the old apprenticeships. They remember the apprentice course which was merely a criminal deception for obtaining cheap labor, they point out instances of apprentices who spent the best part of their training periods at sweeping, cleaning and other common labor. They do not realize that modern apprentice courses are something altogether different, that employers who hire apprentices do so because they realize the need of industry for skilled men, and that the exploitation of boys is no longer possible even if an employer should wish to try it. All these old prejudices and suspicions must be overcome before the manufacturer can get fully under way with his apprentice training work. How can the manufacturer do this better than by retaining his apprentices through a dull business period? Each apprentice becomes the center of an ever widening circle of good will and confidence which soon permeates the entire community.

Of course the argument will be made that it is much simpler to explain the advantages of keeping apprentices at work in dull times than to find work for them to do. However, it is really not so difficult to find solutions for the problem. In the first place, it is largely a question of attitude; the employer who is sincerely in favor of apprenticeship will not consider the problem of restricted activity of any importance as far as apprenticeship is concerned.

Up-to-date apprentice courses include a certain number of school hours in order to impart to the apprentice the necessary theoretical instruction. Ordinarily these hours are distributed throughout the apprentice course in periods of a half day or a day per week. This school instruction is an essential part of the apprentice course and is specified in the contract. It has been found practical in some cases to permit apprentices to attend school full time when there is little work in the shop. They are given credit for this time at school and after conditions have improved they may omit school work until the credit is used up. This arrangement is far from ideal because a certain relation between school work and shop work should be maintained wherever possible. However, it is much to be preferred to the alternative of laying off apprentices.

Very frequently apprentices desire leave of absence from their contracts for a considerable period of time for various reasons. Necessary rest, visits to parents at great distances, completion of high school or college education are a few of many such reasons. Ordinarily such leaves of absence need not be granted at any one time rather than another and the employer who anticipates a dull business period can usually induce the apprentices to take leave of absence when the slack period comes.

Occasionally business depression does not affect all the plants in a district. This is apt to be the case when there is a variety of manufacturing in the neighborhood. Under such circumstances, the plants in the district can be organized in such a manner that those shops which are busy will absorb apprentices from the plants which are running slack.

Living up to the Contract

Finally, it is possible for the management simply to forbid the laying off of a single apprentice. This is justifiable by reason of the contract which requires the apprentice to remain at work in one organization for three or four years while other employees are free to come and go as they please. In return, the apprentice may be considered entitled to work during the period covered by the contract. This method, however, has little to recommend it as it tends to antagonize the men in the shop. They will suspect the management of giving apprentices undue favor and there is danger that this will react unfavorably upon their treatment and instruction of the boys.

Efforts made to employ apprentices in depression are amply rewarded when prosperity returns. The boy who has been kept at work during dull times feels gratitude toward his employer and easily becomes enthusiastic about his work and the organization to which he belongs. Unscrupulous employers will attempt in vain to induce him to break his apprenticeship agreement for higher pay. The apprentice will be willing to exert himself beyond usual requirements when necessary in order to get out a rush job on time. And, most important of all, the employer will be given the confidence of the public in his apprentice training activity.

Composite Brake Drums of Iron and Aluminum

By J. A. LUCAS

Complete brake assembly. The assembly includes the steering knuckle and the arm on which the two brake shoes fulcrum; also the long steering spindle and hydraulic shock absorber

THE Lancia engineers have combined cast iron and aluminum in the construction of brake drums, so as to secure the strength, wear, and desirable braking-surface qualities from cast iron, while at the same time utilizing the heat-conducting properties of aluminum in order to prevent overheating of the brake in mountainous country. The base of the brake drum is a cast-iron ring having numerous projections, each presenting dovetailed surfaces to aid in anchoring the aluminum band that is cast on the outside. The aluminum is cast in the iron mold shown in Fig. 1, gates being provided at six points around the rim so as to insure an even distribution of metal and to maintain an even temperature in casting and cooling. The brake-drum casting is shown just as it comes from the mold. The cast-iron ring is preheated and held in the iron mold shown before the aluminum is cast around the outside. Machining the drum, both inside and out, is done by the usual method. The arms shown are cast in place simply to aid in securing an even flow of metal and to aid in holding the drum in shape during the cooling process. These arms are removed before machining.

The methods of boring the cast iron and also of turning the grooves in the aluminum are not unusual in any way and are consequently not illustrated. One of the brake shoes is shown in Fig. 2. It is an aluminum casting having a deep rim in order to insure sufficient strength in the direction of pressure. The brake band is held in position by the aluminum rivets shown. Machining the brake shoes involves the use of the special four-purpose machine shown in Fig. 3. The machine was built for this particular job, and includes a four-spindle drilling machine, a milling machine, a lathe and a multi-spindle drilling head for drilling all the rivet holes at once. Beginning at the left, the bearing or suspension holes for the shoes are drilled in pairs in

Fig. 1 — A brake drum with the aluminum cast in place outside the cast-iron lining. This view also shows the permanent iron mold in which the pre-heated cast-iron center is placed and where the aluminum is cast

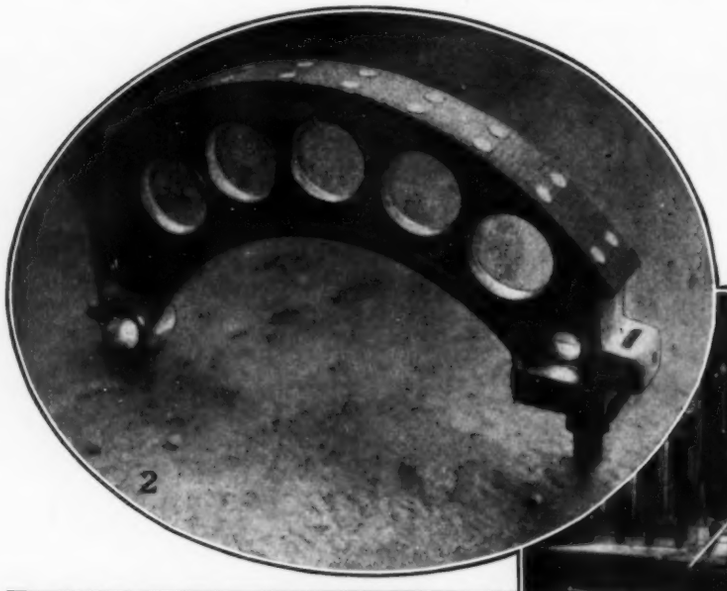


Fig. 2—One of the brake shoes completed and ready for assembling. This is also of aluminum cast in an iron mold, and shows the brake lining held in place with aluminum rivets. The operating face of the shoe is provided with a steel stud that takes the wear

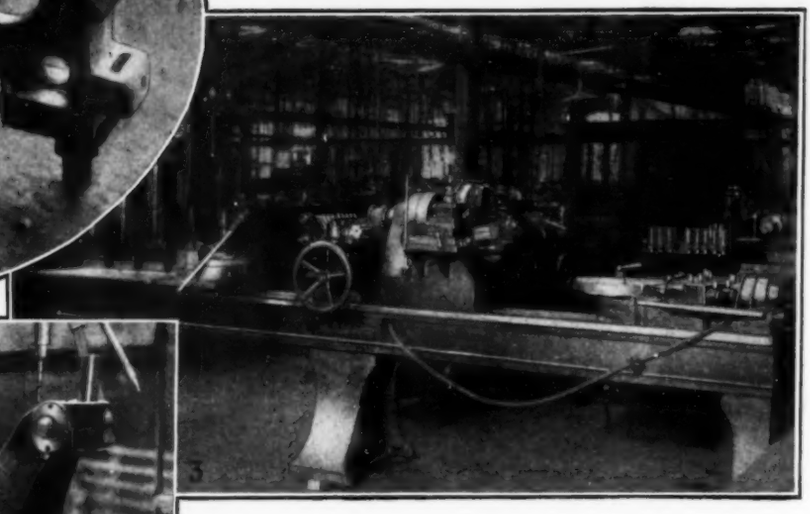


Fig. 3—Combination machine on which the brake shoes are completely finished. This includes drilling the holes, spot facing the hubs, milling the surface for the under operating reinforcement, turning the outside of the shoes, and finally, drilling the rim for the riveting of the brake band

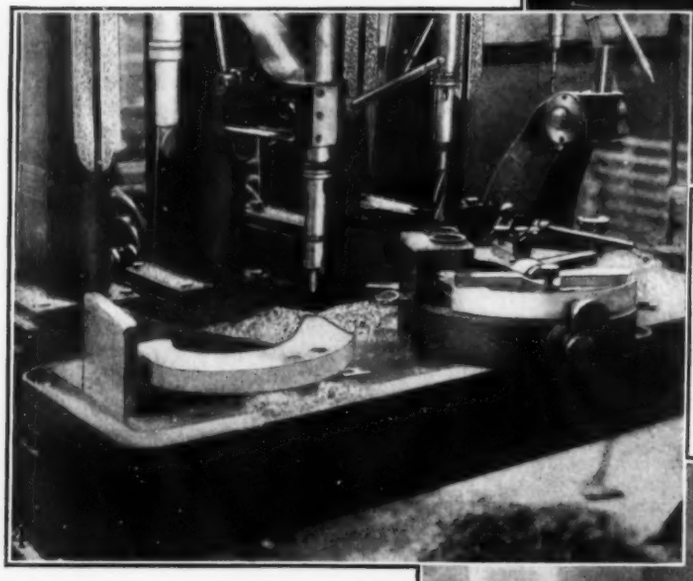


Fig. 4 — The first operation on the brake shoe. Here the fulcrum holes are drilled in pairs in the fixture shown at the right. For spot facing, the shoes are placed under the spindle at the left

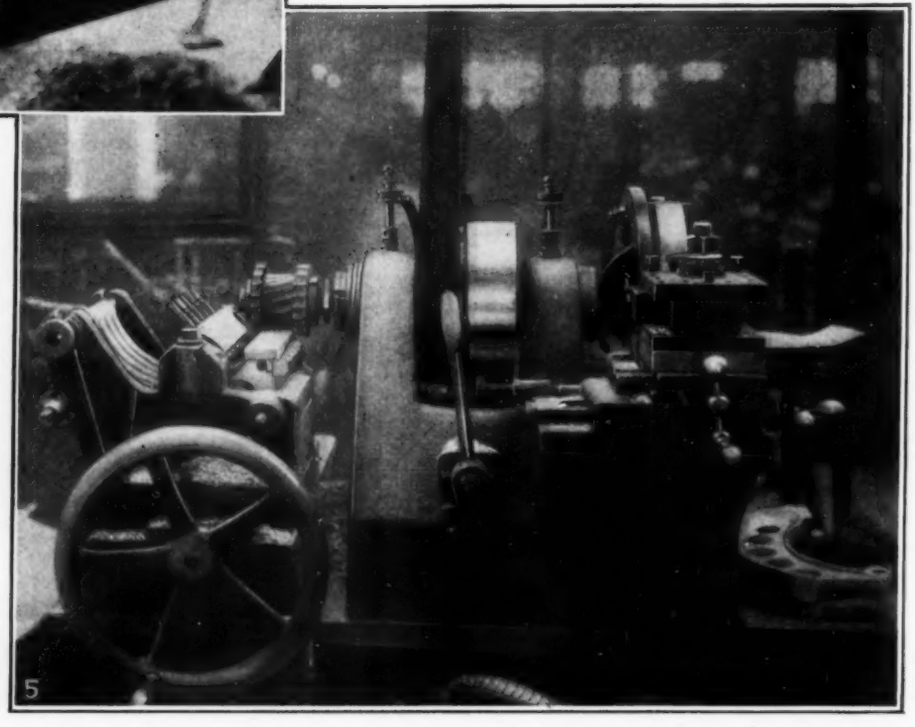
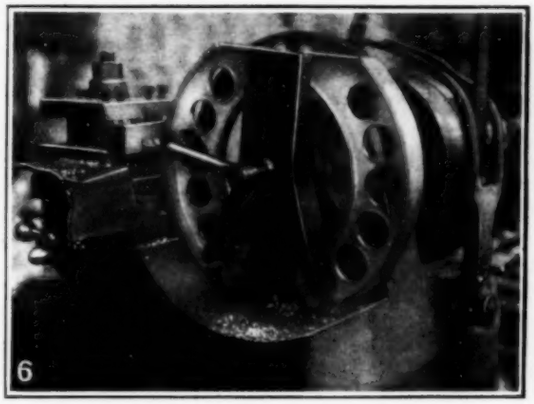


Fig. 5 — Combined milling machine and lathe which mills the actuated surfaces of the brake shoes and also turns the outside at the same time. The milling fixture at the left carries a number of brake shoes, aligning them by a road through the fulcrum hole. The other end is being milled for the reinforcement against which the actuating cam operates



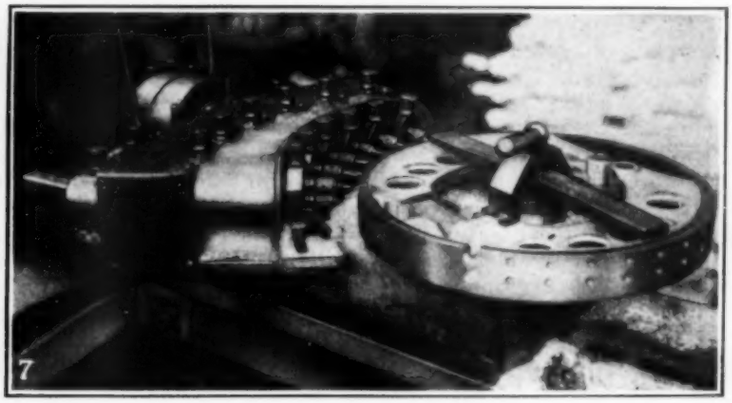


Fig. 6—The lathe end of the combination. This view shows how the brake shoes are located on the face plate of the lathe end of the common spindle and also how the two shoes are held in position by the forked clamp. The proper spacing of the lower end is determined by the block shown at the bottom between the forks of the holding clamp. Fig. 7—Drilling the holes for riveting on the brake lining. There are six pairs of spindles, each being radial with the center of the holding fixture. On account of the close spacing it is necessary to use right- and left-hand drills in adjoining spindles. The spindles are driven by suitable bevel gears, and each pair is fed into the work by a cam plate located in the base of the fixture below the spindle. The method of clamping is clear

the fixture shown at the right of Fig. 4, and are then faced one at a time under the spindle at the left. The manner of holding the brake shoes on the drilling fixture can be easily seen by a little study of the illustration.

The machine next in line on the combination bed is the combined milling and turning head shown in Fig. 5. The left end of the main spindle carries a gang of three milling cutters that surface three sides of the operating end of the brake shoes, the shoes being held in position by a rod through the fulcrum holes previously drilled. As can be seen, this machine handles several brake shoes at one setting in a quick-acting fixture.

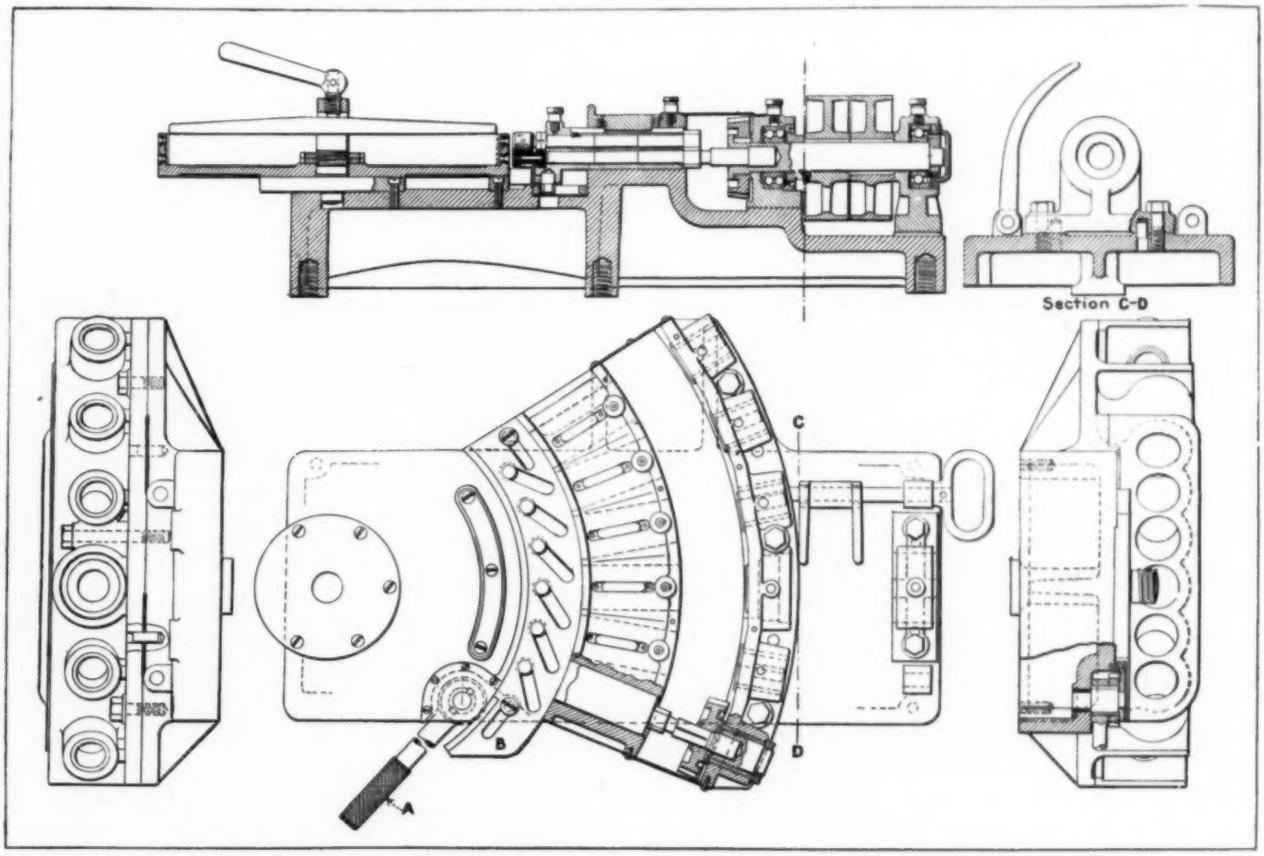


Fig. 8—Details of machine for drilling riveting holes in brake shoes. The swinging handle A moves the cam plate B and feeds all the spindles into the work at once

On the other end of the main spindle is a special faceplate carrying two studs on which the pair of brake shoes are located for turning. The construction of this combined milling and turning head can be seen in Fig. 6, while the method of holding the two brake shoes is also indicated here. Both the milling and the turning operations are carried on simultaneously, the direction of rotation of the milling cutters requiring the turning tool to be upside down.

Drilling the rivet holes by a special drill head is shown in Fig. 7, this operation being the last one on this machine. This view shows how the two shoes are located by their fulcrum holes, on the inside of the steel ring that acts as the bushing plate for guiding the drills. It also shows the simple and effective manner of clamping the two shoes in the fixture by slipping a bar underneath the central yoke and clamping it with a screw.

Owing to the close center-distances of the drilling spindles, it is impossible to interpose any intermediate gears, so that alternate spindles revolve in the opposite direction. This involves the use of both right- and left-hand drills. The feeding of the six pairs of drill spindles is accomplished by a plate below the spindle that carries an angular slot or cam for each spindle. A pin projecting downward from a shoe on each spindle fits these slots, so that a comparatively small side movement of the plate through a suitable handle, advances all the spindles in unison, drilling the holes through the rim of each brake shoe simultaneously.

The essential details of this drilling machine are given in Fig. 8, which shows the drilling head in section; the spindles; the drill chucks and guides; the driving mechanism at the back; and the way in which the brake shoes are clamped. It also shows the operation of the cam plate in feeding the drill spindles.

The completed braking mechanism with the shoe assembled inside the brake drum, and including the brake support, the steering knuckle and the tube which act both as a spindle and a recoil mechanism, are all shown in the headpiece. A little study of this illustration will show the mechanism clearly. Utilizing the special machine shown in Fig. 3 enables one man to handle all the work on the brake shoes at the rate of between 60 and 80 per day of eight hours. This makes the machining cost very small, reduces time in handling, and saves considerable in the inventory of parts in process.

Substitution of Steel Castings for Cast Iron in Machine Tool Construction

By H. J. Hart
Superintendent, Pittsburgh Engineering Works

CAST iron has been a most useful metal and has served a highly valuable service in the manufacture of machine tools. The cupola for producing castings is a comparatively cheap piece of apparatus, simple in construction though highly uncertain in the results of its operation. Nevertheless, cast iron has been used practically universally for the construction of machine tools.

It is amazing, in view of the modern development of the electric steel foundry and the wonderful qualities of steel castings obtainable therefrom, how persistent the machine tool builders seem to be in the use of their old-time, though uncertain standby—cast iron.

Cupola iron castings ordinarily show a tensile strength ranging from 18,000 to 24,000 lb. per sq.in., or under exceptional conditions up to 36,000 lb. per sq.in., when sound, in simple form, and free from shrinkage strain or defects, a condition which by no means prevails with regularity and certainty, but is exceptional.

Electric steel castings, by the same token, run from 70,000 lb. per sq.in. up to 240,000 lb. per sq.in. in tensile strength, with a toughness or elongation many times that of cast iron, generally showing a ductility of twenty to forty times that of cast iron and with a modulus of elasticity (rigidity) of two or more times that of cast iron.

Furthermore, with steel castings it is quite possible to obtain an annealed casting that can readily be worked and machined cheaply and accurately to form and afterwards hardened so as to produce toughness, resistance to abuse, and wear not obtainable to anything more than a fraction of the same degree with cast iron.

Why lathe builders continue to use cast iron for such parts as compound rests and slides, or carriage cross slides, is hard to fathom in view of the foregoing. These smaller parts on a lathe are continually giving trouble from serious wear and breakage, and weakness and lack of rigidity, all of which could be easily and certainly overcome by means of steel castings.

In the best of modern electric steel foundries, it is quite possible to obtain steel castings as true to form, smooth and sound as the best iron castings. Surely the machine tool builders are not acquainted with the advantages of such castings or the users of machine tools would not be permitted to suffer the delays, lost time and repair troubles that now prevail. There are many other parts of lathes that are sadly in need of stronger, better castings; as, for instance, the lathe carriages, the tail stocks, the face plates and some of the larger gears.

Machine tools have been wonderfully improved in the last ten years by the use of flood lubrication, ball and roller bearings, quick traverse mechanism, and stouter, more rigid spindles and construction. In view of all these improvements it would appear that amongst the most essential things that could be done to improve the machines still further would be the use of steel castings.

Another marked advantage of steel castings is the weldability of them. With modern gas and electric welding devices, it is still difficult to build up or repair cast iron in any reliable or ship-shape form, whereas the problems are quite easy and simple where steel castings are used.

A number of the up-to-date foundries are now able to furnish alloy steel castings, such as nickel, nickel-chrome, or medium carbon, high manganese steel, that would make a wonderful improvement if used in the construction of the minor parts of machine tools. Why not let us have stronger, more durable parts that won't break?

Characteristics of Bronze Bearings

The application of alloy steels or specially hardened steels to shafts or journals in mechanical units has enabled the engineer to use new types of bronze bearings that would have been disastrous in the days of common steels. Moreover, improved methods of accuracy in machining such rotating parts no longer require a bronze bearing that has as one of its characteristics a conformability or plasticity to compensate for the irregularity of the workmanship in machining the journal itself. It is now possible to use the harder steels for the shafts or journals, and the harder bronzes for the mating surfaces.

A bronze bearing is essentially a mixture of hard and soft crystals, the hard crystals being the supporting media for the load, and the softer crystals being the matrix in which the harder crystals are embedded. When subjected to wear, the softer crystals abrade first, forming microscopic pockets in which the oil film is held. The harder crystals do not abrade as fast, but they must not be out of proportion to the hardness of the material in the shaft in order to prevent scratching of the shaft with consequent increase in friction and destruction of lubrication.

The chemical control, or control of the mixture, of a bearing bronze is important, but it must be noted that a bronze of a given chemical analysis may, when examined under the microscope, show a diversity of structure, each variation of which will have a definite hardness because of the difference in the amount of hard crystals present. It is therefore apparent that laboratory control of the manufacture of the bearing bronzes is essential to insure uniformity of structure.

A true bronze is an alloy of copper and tin, and the copper-tin alloys have been found to be very satisfactory as bearing metals. Tin forms a chemical combination with the copper, and the resulting tin-copper crystals give the required structure for a bearing metal. To avoid oxides that will detract from the effectiveness of the bearing, the alloy is usually deoxidized with phosphorus or some other material. This makes a third element entering the structure and varying the characteristics of the bearing metal, as any excess of the phosphorus above that required for deoxidizing will remain in the metal.

Lead is sometimes used in bearing bronzes, but it does not combine chemically with the copper, and is carried in suspension. If carefully made a bronze alloy containing lead will have the latter metal evenly distributed, but when improperly controlled the lead is likely to be in globules or streaks, with a resultant poor bearing metal. In general, lead weakens the alloy, but small amounts give plasticity and a tendency for lubrication where the oiling of bearings may be neglected. Bronzes containing lead are frequently used for general machine bearings for high-speed duty, but are not recommended against hard-steel shafts or where the bearing pressure is very high.

Zinc combines chemically with copper in alloying, but zinc alloys, or "brasses," do not make good bearings because of the lack of difference between the hard and soft crystals in the structure. Bronzes containing some zinc, however, cast well, and are used for bearings operating at average speeds and loads. By careful selection and control of melting, a bronze containing zinc and lead with less tin can be prepared retaining many of the characteristics of the straight copper-tin-lead alloy, and giving a cheaper metal. Such alloys are employed for machine bearings where speeds are not high. A high zinc content, with the total elimination of tin, has also been used in bronzes containing aluminum. Such "bronzes" have high compressive strength, excellent anti-frictional qualities, and are employed for motor and machine-tool bearings.

A bronze containing 80 per cent copper and 20 per cent tin, deoxidized with phosphorus, is recommended for heavy-duty bearings. It has a tensile strength of about 33,000 lb. per sq.in., and a compression of 0.001 in. at 28,000 lb. The hardness is 130-143 Brinell. When there is a perceptible phosphorus content the alloy is claimed to be suitable for heavy-duty thrust bearings or for high bearing loads against hard steel surfaces. A standard bearing bronze contains 90 per cent of copper and 10 per cent of tin. The tensile strength of this alloy is as high as 37,000 lb. per sq.in., and has a Brinell hardness of 61 to 70. A general bearing bronze for average machinery requirements is made up of 86 per cent of copper, 9.5 per cent of tin, 2.5 per cent of lead, and 2 per cent of zinc. When the shaft speed is high, and where the journals are not heat-treated, a bronze containing 80 per cent of copper, 10 of tin, and 10 of lead, makes a satisfactory bearing. In the high-tin bronzes laboratory control during manufacture is especially important.

Plain bearings are sometimes condemned as not suited to the job when the fault has been in the design or application rather than in the material itself. Every oil groove in the face of a plain bearing reduces the bearing area, and only necessary grooves should therefore be cut. An oil groove should be well chamfered at its edges, so as to help the oil film to develop rather than to scrape the film from the journal. Bronze bearings must be properly supported to obtain the best service, and it is bad practice to recess the back of a bushing to save weight. Another important point of attention is the clearance between the shaft and the bearing. The allowance for oil film between the two mating parts must be sufficient to permit a satisfactory oil film to be present all around. Where hard steel shafts and hard bronze bearings are used accurate machining will produce the proper bearing surfaces without the necessity of "running in," or the need for plasticity in the material.

For the information given we are largely indebted to the Lumen Bearing Company

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· TECHNICAL · ABSTRACTS ·

Results of a Century of Machine Tool Development

The phenomenal advance in the design and construction of machine tools in the last 100 years has been responsible for the development of all of the industrial machines of today and has made possible our present system of "mass production" or "interchangeable manufacturing." These developments have been made possible by the increases in size and accuracy of the existing machine tools and the invention by Americans of the milling machine, the turret lathe, the automatic lathe and the grinding machine.

The great growth in size of basic machine tools has been brought about by the ever-increasing demand for larger industrial units. Today, lathes that will machine cylindrical surfaces up to fourteen feet in diameter and planing machines that will handle work sixteen feet wide are advertised as regular product. The future holds possibilities of even greater undertakings.

Greater accuracy in the manufacturing of industrial machines and machine tools has been accomplished by the use of more accurate measuring devices and of grinding machines to produce finished surfaces. At present even large machinery is ground to correct size. Both these developments have been conducive to the growth of interchangeable manufacturing.

The most important machines for mass production are the turret lathe, the automatic lathe and the milling machine. There can be little doubt but that our great wealth is due in no small measure to the development of these modern tools.—Dexter S. Kimball in the chapter on Machinery and Power, from "A Century of Industrial Progress," published by Doubleday, Doran & Co.

Hints on Grinding Shoulders

One of the common troubles encountered in cylindrical grinding is that when squaring a shoulder that is integral with a shaft the face of the shoulder does not come exactly square, or at 90 deg., with the axis of the shaft. There are several factors that may cause this trouble, chief among which is misalignment of the work centers. If the machine is an old one the first thing to be checked is the straightness of the ways upon which the head- and foot-stocks slide.

If these are found in error they should be scraped to a master straightedge, taking care not to change their alignment. Next, the corresponding parts of the head- and foot-stocks should be scraped until the centers are in plane with each other. Special centers, accurately fitted to the tapered holes in the spindles, are needed, and these should be ground square upon the ends instead of having the usual 60 deg. points. They should project at least 6 in. from the spindles, and the extensions should be ground accurately parallel as well as of the same diameter.

When the centers are brought together by moving the head- and foot-stocks toward each other on the table ways they should show no appreciable error in alignment when tested with a sensitive indicator, whether at either end or midway of the table.

To prepare a grinding wheel for squaring a shoulder that is to take end thrust the usual method is to dress a recess on its side so that only $\frac{1}{8}$ or $\frac{3}{16}$ in. of the surface will come into contact with the work. This causes the wheel to cut faster and also keeps it from burning the work. A still better method, which reduces the diamond cost, is to use a wheel with a tapered side, say $2\frac{1}{2}$ in. wide at the face and tapering down to 2 in. thick at the wheel sleeve. The wheel wears smaller in diameter at about the same rate as the corner wears away, thus keeping a sharp cutting edge at all times.—*Abrasive Industry*, April.

Increasing Speeds of Standard Cars

How the Morris Garages, Oxford, England, take a standard Morris-Oxford chassis and make it a higher-speed sport car is of interest from a mechanical viewpoint.

The engine is completely disassembled, the valve guides removed and the inlet and exhaust parts are ground and polished, an exhaust fan removing the abrasive. Bearings are tested for alignment and clearance, studs tightened if necessary, piston clearances tested and piston and rod alignment checked, after which a kerosene spray cleans the block thoroughly. Valve springs of 75-lb. pressure are used and a specially wound magneto with a larger range of contact breaker movement installed to handle the higher speeds. These changes make possible a speed of over 4,000 r.p.m. and 3,000 r.p.m. can be maintained indefinitely which is equivalent to 50 to 55 m.p.h. on high gear. Running-in tests of 30 hr., or equivalent to 750 miles road test are given.—*The Automobile Engineer*, March.

Adding Life to Gear Drives

Continuous and efficient operation of all types of gear drives depends to a large extent upon the attention given to installation, inspection and general maintenance. These conditions are also true of speed reducer and chain drives, although they generally run under more ideal operating conditions than does open gearing. In installing a speed reducer drive, a sturdy and level foundation is necessary. If the foundation is of cement, it should be thoroughly seasoned, because any subsequent shrinkage will probably cause maladjustment of the entire set-up. Use of a good grade of flexible coupling is recommended for connecting the speed reducer to the motor.

When forcing the collar or the gear onto the shaft care should be taken that the end of the shaft is properly backed up, so that the driving shock may be absorbed as completely as possible. If this is not done injury to the bearing or to the gears will result. Loose or worn bearings are frequently the cause of much trouble in the operation of speed-reducer drives.

Adequate lubrication is an important factor in the efficient operation of gear drives, particularly of speed reducers and chains. A steam cylinder oil is generally found to be the better lubricant for speed reducers, of the worm and gear type. Heavy oils or greases should not be used except for very slow-moving drives or when especially recommended by the manufacturer. Graphitic compounds are often suitable.

The oil level should be inspected about once a month, depending upon the duty. This inspection is carried out to the best advantage while the speed reducer is idle, but not cold. If, upon inspection, it is found that the oil does not flow, the oil level should be raised. At the time of these inspections it is well to try all bolts for looseness and to test shafts for alignment. Should oil leakage, other than a few drops, occur at the shaft, the gland requires tightening. Care should be taken that the gland is not unevenly or excessively tightened, because to do so will cause oil leakage, possibly overheating and undue wear on shafts.

The mechanical principles governing the installation and maintenance of speed reducer drives also apply in general to chain drives. For example, chain drives should be mounted as close to the bearing as possible. A suitable hanger for outboard bearings should be employed in order to insure a substantial mounting. The motor should be firmly bolted down to prevent movement or turning and also to eliminate as much of the inevitable vibration as is possible. It is important that the pinion be lined up in the midportion of the play of the alignment shaft.

If a chain becomes gummy during the course of operation, it should be cleaned with kerosene; following this treatment the chain should be properly lubricated. In some cases there is a tendency on the part of the chain links to crowd together. In such cases the links should be spread out, so that they occupy the full length of the pins, and then well lubricated with oil.—By M. T. Schumb, *Industrial Engineering*, March.

IDEAS · FROM · PRACTICAL · MEN

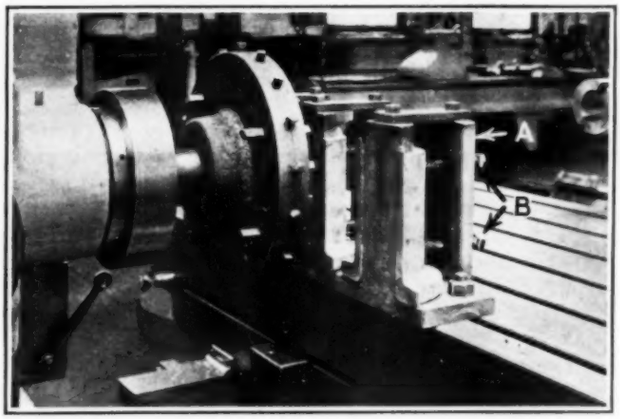
The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit

Machining Journal Brasses

By F. Devine

The Fulton County Shops of the Georgia Power Company overhaul and make replacement parts for the Atlanta trolley cars, and are required to make regularly, large quantities of split journal-brasses. The joints of the brasses were formerly faced by planing, but lately the four fixtures shown in the illustration were made so that the work could be done by milling in a horizontal boring mill.

The front uprights of the fixtures are shaped on the rear faces to accommodate the halves of the brasses, which are forced against them by the screws *B* in the rear uprights *A*. The front and rear uprights are tied together at the tops by straps making them stiffer. The cutter head has twenty tool-bits held in square openings by setscrews.



Fixtures and cutter head for facing joints of journal brasses

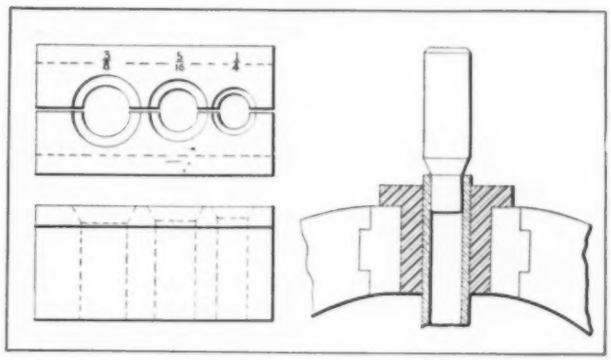
In boring the brasses, they are mounted in pairs in an open-end fixture attached to a faceplate in the same boring mill. In turning the outsides, they are held between collars on a mandrel, the collars being provided with setscrews to pinch the ends of the brasses. The brasses are of twenty per cent copper, with a high percentage of antimony and some tin.

Tools for Bellmouthing Tubing

By H. L. Wheeler

A handy punch and die set for bellmouthing brass and copper tubing is shown in the illustration. It covers the three sizes of tubing most commonly used and takes up but little room in the toolkit.

The die is made in halves and has about $\frac{1}{32}$-in. clearance on the center line for squeeze when clamped on the tube. A shoulder on each side keeps it in place in the vise. The punches have pilots that enter the tubes freely and are beveled so as to flare the tubes when driven in by a hammer.



Tools for bellmouthing tubing

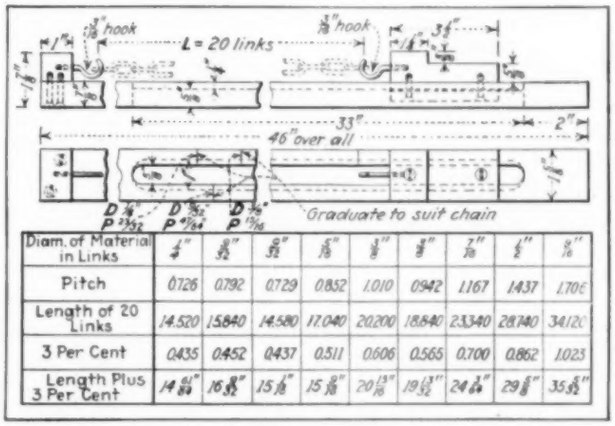
In use, a tube is inserted in one of the holes, projecting an amount equal to the length of the flare desired. A light squeeze of the die in the vise is sufficient to hold the tube while the punch is driven in.

Gage for Detecting Wear in Load Chains

By Phil Simoneau

The proper working of hoisting apparatus depends largely upon the condition of its load chain. A stretched or worn chain will wear the sprocket and result in inefficient operation.

In the illustration is shown a gage for testing the correct length of chains having links, the material of



Diam. of Material in Links	1/4"	9/32"	5/16"	11/32"	3/8"	13/32"	7/16"	1/2"	9/16"
Pitch	0.726	0.792	0.729	0.852	1.010	0.942	1.167	1.437	1.706
Length of 20 Links	14.520	15.840	14.580	17.040	20.200	18.840	23.340	28.740	34.120
3 Per Cent	0.435	0.452	0.437	0.511	0.606	0.565	0.700	0.862	1.023
Length Plus 3 Per Cent	14 61/64"	16 5/32"	15 1/16"	15 5/16"	20 13/16"	19 3/32"	24 1/64"	29 5/8"	35 5/32"

Gage for detecting wear in chains

which is from $\frac{1}{4}$ to $\frac{9}{16}$ in. in diameter, and varying in pitch from 0.726 to 1.706 in. The gage consists of a slotted and graduated bar carrying a stationary and a sliding block, each having a hook attached thereto. The graduations are such as to show the correct length of twenty links of the chain.

In use, one link of the chain is put on the hook on the stationary block and the twentieth link is put on the hook in the sliding block. The sliding block is pulled back, stretching the chain, at which time the graduations will show any variation from the correct length. The entire chain can be gone over, twenty links at a time.

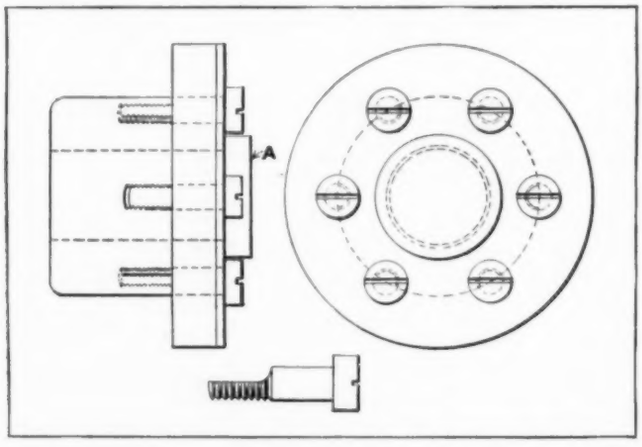
The table gives the diameter of the material in the links, the pitch, the length of twenty links and the amount of three per cent variation from standard in that length of various chains.

Half-Turn Screws for Holding Work

By H. Moore
Hamilton, Canada

The fixture shown in the illustration was made for holding shouldered disks while grinding the face of the projection *A*. The disks were quite thin at the larger diameter, necessitating a number of screws to hold them flat on the fixture.

As much time was lost in taking out and putting in the screws when changing the work, we turned down the rear part of the fixture, cutting away slightly more than



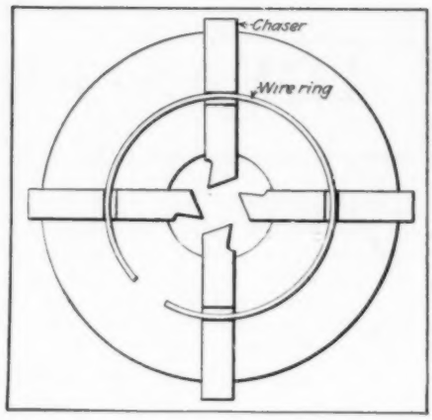
Fixture with half-turn holding screws

one-half of the diameter of the tapped parts of the holes. One-half of the threaded part of each screw was then ground off, as shown. By this arrangement, the screws could be pushed all the way in, and by giving them a half-turn they held the work securely.

Cutting Good Threads With a Worn Die-Head

By H. Boase
Liverpool, England

Trouble was experienced in using a $\frac{3}{4}$-in. Geometric die-head that was badly worn, due to excessive radial play of the chasers in their slots. The chasers would drop as they came into the upright position, successively, making it necessary for the work to push them up as it entered the die. This condition caused bad starting threads, particularly where the chamfer at the ends of the chasers had been reduced to the minimum, for cutting threads close to a shoulder. To overcome this difficulty, a narrow groove was ground in the front face of each chaser, using a thin wheel. When the chasers were in place in the die-head, an open ring made from No. 18 spring-steel wire was slipped into the grooves. As the grooves in the chasers were slightly undercut and the spring-ring was larger in diameter than the distance between the grooves when the chasers were in place, the ring kept the chasers in the outward position at all times. The sketch shows the idea. Since the adoption of this remedy no further trouble has been experienced.



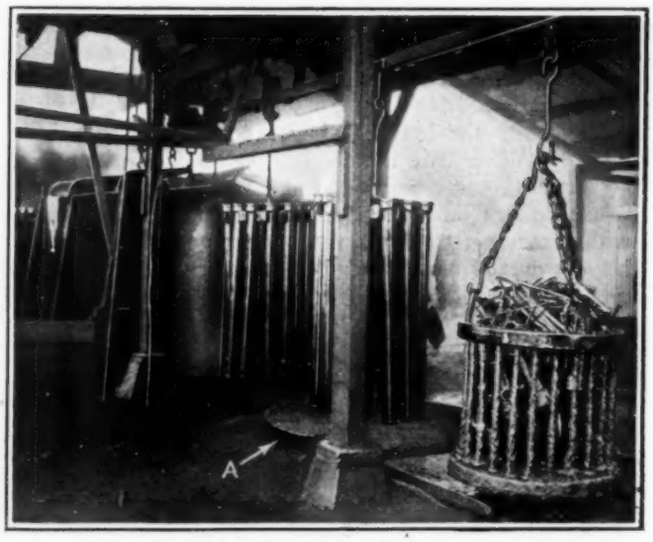
A remedy for loose chasers

Coating Cast-Iron Parts to Withstand Moisture

By J. S. Browne

Where cast-iron parts are required to be protected against exposure to weather conditions, a coating of tar can be used, either with or without an outside coat of paint. The accompanying illustration shows the method used at one plant for finishing pipe fittings, pipe, and various other cast-iron articles. The work is suspended from an overhead rail and passes through the furnace at the left, where it is heated to a temperature of about 400 deg. Fahrenheit.

The tank at *A* is 5 ft. in diameter, 9 ft. 6 in. deep, and contains the tar. When the work is pushed from the furnace to a point over the tank a section of the overhead rail is lowered by means of an air hoist, and is



Method of hot-dipping cast-iron articles

dipped. The heat from the work keeps the tar in a fluid state, so that no outside heating of the tank is necessary. The tar penetrates the pores of the hot iron, and one dipping gives the necessary coat. If the cast iron is allowed to get too hot in the furnace, the coating of tar will have a dull finish. The parts are thoroughly dry and can be loaded into cars for shipment 5 min. after dipping. When dry there is no odor of tar on the parts. Service tests show that castings hot coated in this way will withstand weather conditions for many years.

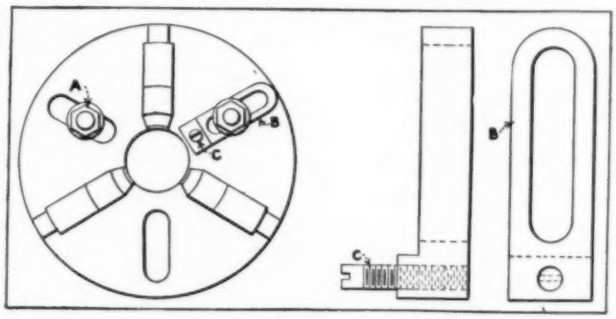
Adjustable Spacer for the Lathe Chuck—*Discussion*

By Charles Kugler

The article by Henry Simon, under the title given above, published on page 986, Vol. 67, of the *American Machinist*, interested me because I have been using a device of a different type for the same purpose.

Where the chuck has slots in the spaces between the jaws, I place a bolt in each slot and clamp it with a nut, as at *A*. After the bolts are all in place, a light cut is taken over their ends to bring them all to the same height. The work is placed against the bolts, enabling it to be faced parallel with the chuck face.

For chucks that have no slots, I drill and tap three holes and clamp pieces, one of which is shown enlarged



Two kinds of adjustable spacers

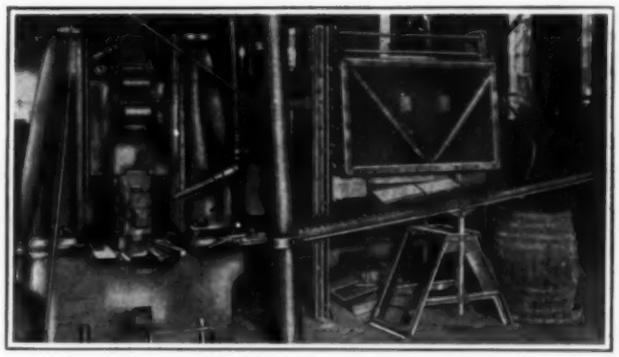
at *B*, to the face of the chuck. These pieces, being slotted, can be adjusted any distance from the center to suit the work. The screws, as at *C* are tight fits and, after being adjusted to the proper height, a facing cut is taken over them to bring them all to the same height from the face of the chuck.

Either of these devices will answer every purpose of the one shown by Mr. Simon, and they have the advantage of being much cheaper.

Gravity Conveyor Aids in Handling Hot Material

By Louis L. Locke

Some of the difficulty in transferring hot slugs from the furnace to the hammer has been eliminated by the installation of a gravity conveyor operated between the units, as shown in the illustration. The furnace is of the pusher type and is loaded from the opposite end. As the material becomes heated to the forging temperature, a slug is pushed from the furnace and onto the conveyor and then travels by gravity to a convenient po-



A portable gravity conveyor for handling hot material

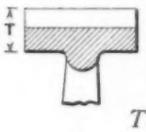
sition at the hammer, so that the operator can easily handle it for forging.

The same conveyor can also be used in connection with quenching or with the unloading of annealed work. For this purpose the conveyor is tipped in the opposite direction to that shown in order that the hot material may be directed to some convenient quenching tank or annealing tray. The conveyor is portable and can be shifted to various positions around the shop.

Thickness of Gear Rims

By Tom Addison

For the beginner in detailing, nothing appears to give him more trouble than finding the proper thickness for the rims of gears. I have devised the accompanying table to show the rim thickness of cast iron gears of



Diametral Pitch	10	8	7	6	5	4	3½	3	2½	2
Thickness of Rim T	9/16"	5/8"	11/16"	3/4"	7/8"	1 1/8"	1 5/16"	1 1/2"	1 13/16"	2 1/4"

Thickness of cast-iron gear rims

from 10 to 2 diametral pitch and hope that it will be of use to detailers, especially the beginners.

The dimensions given have been used for some time by a well-known concern making a specialty of planers and are to be all right for cast-iron gears.

Dimensioning Drawings—*Discussion*

By Jos. E. Abbazia

In his article under the title given above, published on page 30, Vol. 68, of the *American Machinist*, C. G. Williams appears to have some pretty clear ideas on the subject.

However, where the dimensions are written $\frac{0.302}{0.300}$ and where the upper one is for the external piece and the lower one is for the hole, I would like to ask Mr. Williams if a piece were turned to 0.302 in. in diameter, how it would possibly be made to fit a hole 0.300 in. in diameter.

My preference would be to give the dimensions as $\frac{0.301}{0.300}$ for the diameter of the external member and $\frac{0.301}{0.302}$ for the diameter of the hole in which it is to fit. This method would eliminate arguments and would give the workman definite limits to work to.

American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

Engineering Service—Curse or Blessing?

FOUR equipment builders out of five will probably say that the engineering service demanded by their customers is an unmixed evil, that they only give it because competition makes it necessary. And they lay most of their lack of profits to the high cost of rendering such service.

But the fifth builder sees farther than his competitors. He admits the cost of engineering service but he maintains that, properly organized, it can be a prolific source of ideas for himself and can provide an efficient entering wedge for admission into the inner production circles. Factory production men have just as many tough problems to solve as any one else—perhaps more—and they are quite as willing to welcome the man whose experience and technical skill may help in the solution. The right kind of production engineer can give real help with the customer's troubles, and while he is studying them on the ground he can collect ideas for improving the equipment built by his own company.

Obviously, the production engineering staff must be so organized and controlled that the customer pays for it in the long run. This is as it should be because the customer gets the benefit of a machine that pays for itself many times over before it reaches the scrap heap, while the builder collects only his profit on the first cost.

Decimals Are Not Necessarily Metric

METRIC advocates seem prone either to misunderstand or to misstate facts in making claims of superiority for use of their system. Only recently a well-known electrical engineer stated that the use of the term kilowatt was evidence of the growing use of the metric system in this country.

This statement is on a par with those of people who consider decimals or tens as the sole property of the metric system. They entirely overlook the fact that the metric system means the use of the meter or millimeter as a unit, just as the English system implies the use of the yard or the inch, depending upon the class of work under consideration.

The metric system has no monopoly on decimals or the use of the Latin or Greek prefixes that designate the various multiplications or divisions of the meter. The use of the term kilowatt has no more to do with the metric system than would kilo-inch or milli-yard, if we found it convenient to use such terms.

No one disputes the convenience of decimals for many purposes, and probably no country uses them to such an extent as does the United States. Binary divisions also retain a firm hold on the human mind in other cases. But neither has any bearing on the use of either metric or English systems. It is the base used, and that alone, that determines the system under consideration.

Castings Face Competition in Machine Building Field

ADVANCES in design and in manufacturing methods mean changes of one sort or another, and, in nearly every case, some group suffers from the change. The introduction of the power-loom threw many weavers out of work and caused riots. The railroads forced the stage coach employees to seek other lines of work. The milling machine, upon its introduction, affected the use of the planer, and has been, in turn, supplanted by the grinding machine in some instances. The turbine, the internal combustion engine and the increasing use of electric power have largely driven the builder of steam engines of the older types out of existence.

Similar changes are taking place in other fields. The foundry is feeling the replacement of castings with sheet metal and parts built from structural steel, and foundrymen are making strenuous efforts to combat the change.

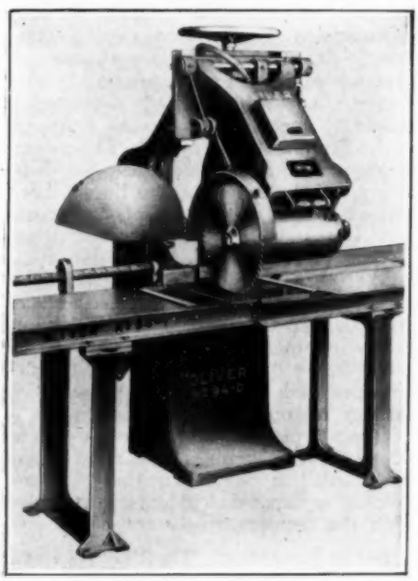
Experience in other lines, both social and economic, indicates that direct opposition to change is frequently the surest way to hasten its coming, and in an undesirable form. A recognition of the coming changes and an endeavor to direct rather than to oppose them, is usually the better policy. The foundry seems doomed to lose part of its former business to other methods that will prove more efficient. On the other hand, it may be possible to secure business in entirely new fields or so to improve cast iron as to make it more desirable for some purposes than its rivals. Obviously, individual and collective research into processes and markets must be undertaken at once if profitable operation is to continue. Several movements in this direction have been started. Their progress will be watched with interest in several quarters.

· SHOP · EQUIPMENT · NEWS ·

Oliver "Straitline" No. 94-D Cut-off Saw

CORRECT operation of the "Straitline" No. 94-D cut-off saw manufactured by the Oliver Machinery Company, Grand Rapids, Mich., is assured by a suspended link motion which permits folding the entire mechanism into the head. In addition to the advantage of not having the saw in the working zone, when not actually cutting, the natural balance of the motor head and the design of the linkage prevent any rebound. The working parts swing in tapered roller or ball bearings; pressure gun fittings provide lubrication in all bearings.

The saw is driven by a 5-hp. motor mounted directly on the saw arbor, running at 3,600 r.p.m., and supplied from 2- or 3-phase, 220- or 440-volt, 60-cycle circuits. The saw arbor is of crucible steel, ground accurately to



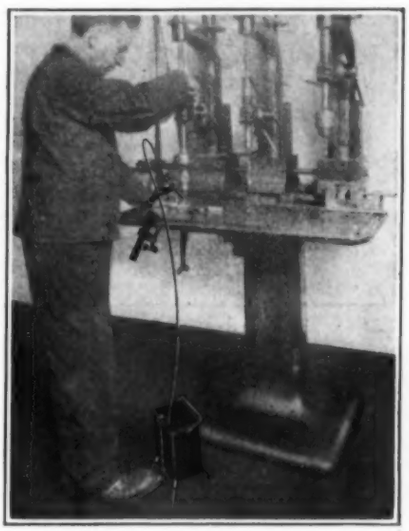
Oliver "Straitline" No. 94-D Cut-off Saw shown with table

1 in. in diam. where the saw is applied, and is fitted with large collars. Dado heads up to 2½-in. wide may be carried. The motor head will accommodate circular saws, dado heads, or solid cutters from 10 to 18 in. in diam. The entire suspended-link mechanism is carried by a yoke with a gibbed way, vertically adjusted by a handwheel and screw with 3-in. vertical adjustment to compensate for wear in saws or the use of different diameter saws. Maximum thickness of cut by using 18-in. saws is 4½ in. Stock 2-in. thick and 20-in. wide, can be cut with ease. An additional feature is that of an automatic starter with a magnetic contactor with low-voltage protection and overload release, which is operated by a push-button stop and start station mounted directly in front of the operator.

A one-piece cored frame casting, with substantial floor base, is designed to enable locating the machine directly up against the wall or back to back with another machine. Small floor space is required since the machine takes up only 18 in. from the wall to the back edge of the cut-off tables. These tables for use in connection with the saw are 20 in. wide, 31 in. high, and can be furnished in any desired length. The standard table consists of two sections of 8 ft. The table used on the left-hand side has a cut-off gage mounted thereon, while the length gage is mounted on the right-hand table. The automatic gage is 8 ft. long, graduated in ⅛ inches, and fitted with four automatic stops, which may be located easily. Four ball-bearing steel rollers are supplied for each section. The weights of the saw and the table, crated, are 1,400 and 700 lb. respectively.

Curran Portable Lubricator

Proper lubrication of cutting operations where the machine is not equipped for that purpose is provided by the portable lubricator manufactured by the Curran Machine Works, 159 Newtown Road, Long Island City, N. Y. The lubricant is directed at the tool from a small flexible hose which may be clamped in any position and is supplied from a ½-gal. tank resting on the floor. The lubricant is lifted by means of a piston pump operated by a pedal. The rate of flow can be adjusted by varying the length of stroke of the pump by



Curran Portable Lubricator

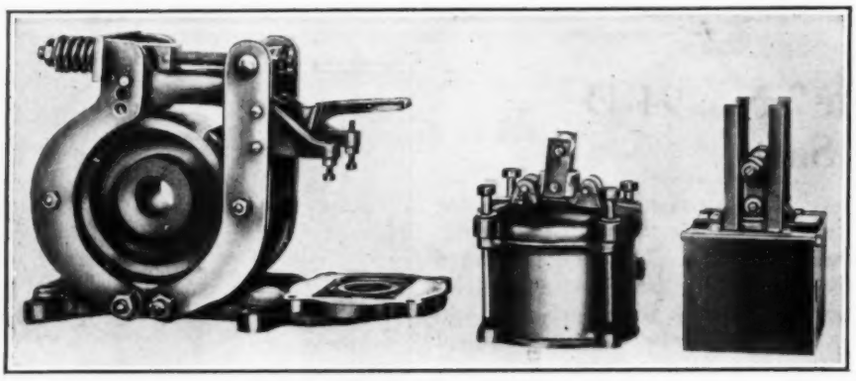
means of a finger nut. The liquid must pass through a strainer before entering the pump. It is claimed that liquids can be handled that vary widely in density, such as turpentine and heavy tapping oil.

General Electric Solenoid Brake

Simplification is the keynote of a complete line of solenoid brakes now offered by the General Electric Company, Schenectady, N. Y. The line, bearing the designation CR-9516, includes brakes for operation on both a.c. and d.c. and involves in its construction the use of a spring-setting device—a feature heretofore not used for a.c. applications.

The brakes are designed for severe service in connection with mill, crane, and hoist motors. The manufacturer claims smooth operation for making quick stops in either direction of rotation, with a dependable holding value. The brake mechanism is held in the "off" position by a coil and plunger; when power is applied to the motor, the coil is energized and the brake is released, and, when the power is shut off, the spring-setting device forces the mechanism into the closed or braking position.

Both a.c. and d.c. brakes use the same brake mechanism and frame, the solenoids being interchangeable. Further flexibility is obtained by making the floor-mounted brake the basic unit



General Electric Solenoid Brake showing d.c. series solenoid and a.c. shunt solenoid which are interchangeable

of the line; by adding the motor mounting bracket, it becomes a motor-mounted brake. The brakes, being spring-set, can be mounted in any position, have adjustable torque, allow no sudden jar from falling armature and have a simple and accessible overhead lever construction.

Very small diameter brake wheels are used, thus minimizing flywheel effect. A wide wheel face gives ample braking surface. The brake shoes are of cast iron and are self-aligning, permitting proper contact with the wheel even when the brake is incorrectly mounted and the wheel is out of line with the center line of the brake both sidewise and up or down. Compressed, woven, asbestos lining furnishes the braking surface for the shoes, and is not affected by heat or moisture.

The brake yokes of plate steel are pivoted below the wheel near the center line and cover the rim on both sides of the wheel so that it cannot come off the shaft accidentally.

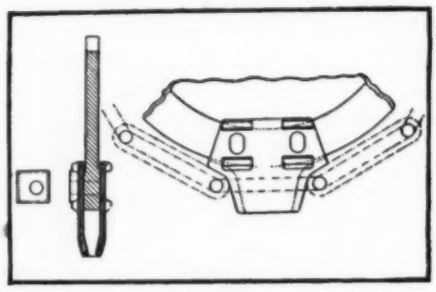
The solenoid assembly may be quickly removed from the brake mechanism by taking out four bolts, the lever or brake adjustments remaining undisturbed. The coil only may be removed, if desired, from the larger sizes.

Morse Cobalt-Steel Drills for Manganese Steel

For drilling high-manganese steel, a cobalt-steel drill has been developed by the Morse Twist Drill & Machine Company, New Bedford, Mass. In a laboratory test, with one grind, it was possible to drill nine holes, 1½ in. deep, in a railroad frog having a content of 1.08 per cent carbon and 10.04 per cent manganese and a Brinell hardness of 207-217. The company is prepared to make drills of cobalt steel for this class of work upon specification.

Union Expansible Tooth Sprocket

Constant maximum efficiency, longer chain life, smoother and quieter running and permanent sprocket installation are distinct advantages claimed by the Union Chain and Manufacturing Company, Sandusky, Ohio, for the expansible



Union Expansible Tooth Sprocket

tooth sprocket which has been recently developed. The teeth of this device may be adjusted from time to time to accommodate the natural wear and consequent elongation of the links of the chain. This elongation, while seemingly slight in any one link, is multiplied by the number of links in engagement with the sprocket, thus causing a misfit between the chain and the sprocket, and a consequent jerky and noisy action which tends to shorten the life of both chain and sprocket.

As shown in the illustration, the teeth straddle and are firmly clamped to the body rims, which have been machined. Turned bolts closely fitted in the rim project through elongated holes in the teeth, the latter being secured relatively to the pitch diameter by means of square beveled-edge adjusting blocks fitted between lugs on the teeth. After the chain has been elongated beyond a proper fit on the sprocket, the nuts are released and the eccentric blocks readjusted so as to expand the teeth to the next larger pitch diameter. The teeth are made from alloy steel.

Pamphlets Received

ACETYLENE VS. FUEL GAS. The International Acetylene Association, 30 East 42nd St., New York, N. Y., is distributing a booklet entitled "The Superiority of Acetylene as Fuel Gas for Cutting." The subject is treated from the standpoints of the laboratory and the shop. Formulas and tables are given for the laboratory tests while data for service conditions are included. The studies were made to demonstrate the superiority of acetylene over city gas for use with the cutting torch.

THERMAL EXPANSION OF "STAINLESS" ALLOYS. The Department of Commerce, Bureau of Standards, Washington, D. C., has issued a pamphlet entitled "Thermal Expansion of Alloys of the Stainless Iron Type." This paper is known as Scientific Paper No. 570, and gives the result of the linear thermal expansion of nine samples of stainless iron which were obtained from various sources. The chromium content of these samples varied from 11.9 to 16.4 per cent and the carbon content from 0.09 to 0.13 per cent. Expansion determinations were made over various temperature ranges between room temperature and 1,000 deg. C. Transformation regions were located on some of the samples, while expansion curves of all of the samples are shown and discussed. It is shown that the coefficient of expansion increases gradually with the temperature.

SALES RESEARCH. The Policyholders' Service Bureau of the Metropolitan Life Insurance Co., New York, N. Y., has released the tenth number of a series of business organization booklets which is entitled "Sales Research." The purpose of this report is to point out the scope and duties of the sales research bureau and the types and problems which can be handled by it, and to offer suggestions to firms having only seasonal or occasional demands of a sales and market analyst. It is illustrated throughout with specific examples of sales research, organization and performance charts contributed by business organizations throughout the country.

NEWS OF THE WEEK

Industrial Earnings Report Repudiates Talk of Hard Times

AN INTERESTING table showing the earnings last year of 709 leading industrial corporations has just been issued by the National City Bank of New York. Although the year frequently has been referred to as one of "profitless prosperity," the actual figures, while they show a decline, do not justify the hard-times talk that has become quite prevalent.

The level of aggregate profits is indicated by the accompanying table which shows them to be 7.9 per cent below those of 1926 but slightly above those of 1925, which up to that time was considered a very good year for business. A total also is given showing the earning of the General Motors Corporation and of all companies excluding General Motors. These latter figures, while making a less favorable showing than the first, can by no means be considered derogatory, with the 1927 figures showing a decrease of 10.5 per cent from 1926 and of 4.1 per cent from 1925.

A further interesting fact revealed in the figures is that if we exclude from the calculation the heavy losses sustained by the oil companies, due to conditions peculiar to that industry, we find that aggregate earnings of the remaining companies are approximately equal to those of 1926 and 8.5 per cent above those of 1925. Railroads experienced a relatively poor year, the report points out with a decline of 11.9 per cent in net earnings, due to the falling off in traffic together with an increase in expenses, largely wages. Seventy-eight telephone companies and 51 other public utilities, on the other hand, increased their earnings 10.7 per cent.

Earnings of 709 Leading Industrial Corporations

No.	Industry	Thousands of Dollars 1925	1926	1927	1926–27	Change 1925–27 Per Cent
10	Agricultural implements	35,249	43,583	44,664	+ 2.5	+ 26.7
14	Amusements	21,862	38,731	39,777	+ 2.7	+ 81.9
27	Automobile and trucks	275,570	313,465	329,230	+ 5.0	+ 19.5
32	Auto accessories	62,293	54,280	48,549	— 10.6	— 22.1
29	Building materials	69,288	57,992	48,387	— 16.6	— 30.2
33	Chemicals and drugs	96,175	120,384	129,377	+ 7.5	+ 34.5
15	Apparel	10,587	11,011	12,589	+ 14.3	+ 16.0
16	Coal mining	8,749	15,522	9,276	— 40.2	+ 6.0
14	Copper mining	24,147	34,994	30,484	— 12.9	+ 26.2
23	Cotton manufacturing	3,459 def.	1,820	10,490	.....	+203.3
21	Electrical equipment	72,556	80,974	80,579	— 0.5	+ 11.1
13	Flour and bakery	72,557	83,734	91,046	+ 8.7	+ 25.5
24	Food products	75,466	87,278	88,698	+ 1.6	+ 17.5
10	Heating and plumbing	27,014	27,892	26,561	— 4.8	— 1.7
38	Iron and steel	191,322	238,696	183,498	— 23.1	— 4.1
11	Leather and shoes	24,304	20,276	31,920	+ 57.2	+ 31.4
33	Machinery	41,441	47,779	38,780	— 18.8	— 6.4
10	Meat packing	34,825	32,701	14,555	— 55.4	— 58.1
65	Merchandising	167,141	173,593	189,013	+ 8.9	+ 13.1
30	Non-ferrous metals (except copper)	86,069	90,845	81,019	— 10.8	— 5.9
24	Office and home appliances	53,617	59,666	62,706	+ 5.1	+ 16.9
11	Paper and products	8,287	6,652	6,759	+ 1.6	— 18.4
54	Petroleum	339,007	394,505	212,405	— 46.2	— 37.3
15	Printing and publishing	25,131	25,364	29,775	+ 17.4	+ 18.5
17	Railway equipment	25,485	47,592	37,444	— 21.3	+ 46.9
15	Rubber	72,874	34,935	50,813	+ 45.6	— 30.3
9	Shipping	7,407	5,441	8,381	+ 54.0	+ 13.2
9	Silk manufacturing	10,392	6,465	4,858	— 24.8	— 53.3
20	Sugar	12,494	6,196	10,684	+218.0	+ 57.5
24	Tobacco	103,575	113,276	117,743	+ 3.9	+ 13.7
5	Woolen manufacturing	2,033 def.	1,997	3,299	.....	+ 62.3
38	Miscellaneous	61,321	61,521	65,642	+ 6.7	+ 7.0
709	Grand total	2,121,967	2,331,526	2,148,001	— 7.9	+ 1.2
	General Motors Corp	126,617	194,645	235,105	+ 20.8	+ 85.7
708	Total excluding General Motors	1,995,350	2,136,881	1,912,896	— 10.5	— 4.1

National Foreign Trade Convention Revises Program

Announcement has just been made of a change in the program of the Fifteenth National Foreign Trade Convention to be held in Houston, Texas, April 25, 26, 27, 1928. The three periods, hitherto devoted to group sessions, will be given over to general sessions in which there will be detailed presentation of export merchandising. All convention sessions will be held in the city auditorium.

Opening Wednesday, April 25, the revised program will be:

Call to order of the first general session by James A. Farrell, chairman of National Foreign Trade Council; address, the Foreign Trade Outlook, by E. P. Thomas, vice-president of the United Steel Products Co.; address, the Prospect in Europe, by George P. Auld, of Haskins & Sells, New York; address, Foreign Trade Developments in the Gulf States, by James P. Butler, president of the Canal Bank & Trust Co., New Orleans.

Three export merchandising sessions are to be held in which will be discussed these subjects: Preparatory Market Analysis, Channels of Distribution, Merchandising Methods, Credit and Finance, Advertising, Co-operation with Distributors and Agents, Packing and Shipping, Marine Insurance, and Legal Protection.

At Friday's closing general sessions there will be addresses on: "Fundamentals of an American Merchant Marine," by Norman F. Titus, chief of the transportation division of the Bureau of Foreign and Domestic Commerce, Washington, D. C.; "The Department of State and American Enterprise Abroad," by Hon. William R. Castle, assistant Secretary of State; "The Foreign Trade Aspect of the Tariff," by George C. Davis, customs adviser of the National Council of American Importers and Traders, Inc., New York; "Foreign Trade Progress," by James A. Farrell, president of the United States Steel Corporation, New York.

Metal Trades Convention to Discuss Production and Labor

METHODS of production and labor will be the major features of the Thirtieth Annual Convention of the National Metal Trades Association to be held in the Hotel Astor, New York City, on April 25 and 26. New officers will be elected and committees appointed for the operation of the several departments.

Howard Coonley, president of the Walworth Co., will address the gathering on "Industrial Budgeting," and Gordon L. Hostetter, executive secretary of the Chicago Employers' Association, will speak on "Rackets and Racketeering" in outlining the criticized practices resorted to by labor leaders, particularly in the Chicago district.

An extended review of machinization and unemployment will be brought before the convention by Magnus W.

Alexander, president of the National Industrial Conference Board. Bernard J. Mullaney, vice-president of the People's Gas, Light & Coke Company of Chicago, will discuss "The Government in Business" as relating to the current public demand that sweeping investigations be made of public utility control by the United States Senate. His interpretations will be in the light of the public interest.

Other subjects on the program are: "Business Profits," by Dr. Charles J. Bullock, director of the Harvard Economic Society; "The Significance of the Present Situation to Change the Laws in Respect to Labor Combinations," by Walter Gordon Merritt, counsel for the League for Industrial Rights; "The Majesty of Law," by Charles Nagel, former secretary of Labor and Commerce. Mr. Nagel will present his subject at the annual banquet to be held on Wednesday evening, April 25. Dr. Samuel W. Grifflin, former director of industrial relations for the Ward Baking Co., New York, also will speak at the banquet on "First Principles."

On Thursday, following the banquet, analyses and discussions of immediate problems in the metal industry will take place. George W. Seyler, of the Lunkenheimer Co., of Cincinnati, will conduct a demonstration and discussion in the training of foremen. "The Story of Chemistry" will be presented by Floyd Darrow. Wage incentives for workmen and supervisors also will come up for discussion.

The two days preceding the convention will be devoted to the semi-annual meeting of the administrative council, the spring meeting of the branch secretaries, the presidents' and secretaries' banquets, the alumni banquet and an especially prepared program for wives of the delegates.

German Metal-Working Machinery Industry Greatly Overdeveloped

Demand is far below the capacity of existing plants

STIMULATED by the increased demand for machinery during the war and the desire to exchange the depreciating marks for something of intrinsic value, German machinery manufacturers have expanded their plants far beyond the requirements of present demand and have thus tied up a good share of their liquid capital, according to Trade Commissioner Theodore Pilger in a trade bulletin just issued by the Department of Commerce. The industry, the bulletin shows, is suffering from a deficiency of working capital and is not in a position to export on a credit basis as in pre-war years.

There are nearly 900 metal-working machinery factories in Germany and although these are operating at perhaps 80 per cent of capacity, they are employing about 65,000 workmen, an increase of nearly 75 per cent in the number of plants and 30 per cent in the number of employees since 1921. With this equipment Germany is making about 13 per cent of the world's machinery. By way of contrast, the United States is producing about 57 per cent of the world's machinery, employing for that purpose less than 400 plants and approximately 45,000 persons.

On the average, in Germany 1.15 hp. is provided for each workman, as contrasted with 4.4 hp. in the United States. As the result of this better equipment and more efficient methods employed by management it is found that on the average the American workman will produce $4,000 worth of work annually as contrasted with $1,000 by his German colleague.

Machine tools shipped from Germany to Great Britain in 1926 averaged 26 cents a pound, while those imported from the United States averaged 34 cents per pound. Machine tools shipped from the United States to Germany in 1925 averaged 34 cents per pound while those shipped from Germany to the United States in the same year averaged 16 cents per pound. These figures, even making allowances for the imperfect character of export values, present a very interesting picture of the comparative positions occupied by the German and the American products on the markets of the world.

In concluding his report Commissioner Pilger points out that the German metal-working machinery industry needs above anything else improved sales methods, less price fixing and a better position in the markets of the world.

Minimum Standards of Performance Are Urged for Electrical Products

Adoption of minimum standards of performance for electrical products as the next logical step in the standardization program of the electrical industry was recommended by W. S. Rugg, vice-president of the Westinghouse Electric and Manufacturing Co., when he, as principal speaker, addressed the second general session of the Policies Division meeting of the National Electrical Manufacturers' Association in Pittsburgh, Pa., on March 15.

Successful standardization already accomplished by the industry, on apparatus characteristics, such as capacity, speed and dimensions, should, in Mr. Rugg's opinion, be followed by establishment of quality levels of performance. Regarding the minimum standard of performance as a direct means of achieving economy and efficiency of production and, more important still, assuring the user of apparatus against unbalanced design and performance, Mr. Rugg described the ideal minimum standard as accomplishing a balance between the lowest cost of manufacturing and distribution; greatest adaptability to the purpose for which the apparatus is to be used; greatest durability; lowest cost of maintenance, and lowest cost of power for operation.

Such standards should be developed to meet the interests of the major groups concerned and should be so adjusted as to require no undue cost of redesign and retooling but should permit a gradual raising of the standard as the producer's skill increases.

Expansion for Cleveland Engineers' Exhibit

Because of the nation-wide interest shown in the continuous exhibit being conducted by the Cleveland Engineering Society, which exposition has been in existence for more than a year, the organization has acquired new space to accommodate many more exhibitors who are eager to get their displays before the Cleveland engineering market.

This exhibit is arranged around the sides of a large meeting room and is used by various other societies in industry and commerce. The total monthly attendance runs from 500 to 1,000 technical and industrial executives. When completed the meeting room will have a capacity of more than 300 persons in addition to 1,800 sq.ft. of display space.

Morocco a New Market for Metal Products

LOCALLY, since the war there has been a considerable and natural growth of production facilities within Morocco. Many French firms have established branch establishments where most operations from castings to construction elements are turned out and machine shops adequate to repair most mechanical tools and instruments have sprung up.

During the past year there were imported 1,210,000 francs worth of wire and 25,140,000 francs of iron and steel manufactures of all kinds. Belgium previously shared most largely in the trade, but latterly France has made great progress. In 1926 agricultural machinery and tools were imported to the value of 17,688,000 francs, of which half were of American origin.

Road tractors, steam engines and gas or oil prime movers, dynamos and machine tools accounted for 30,711,000 francs, coming largely from metropolitan France, though unquestionably no inconsiderable part of these were transshipped and may be considered as of American manufacture.

Machine parts accounted for 12,363,000 francs, tools for 3,766,000

francs, building hardware and construction elements of metal for 7,940,000 and electric cables for 3,435,000 francs. Railway rolling stock reached a value of 7,041,000 and rails were valued at 6,763,000 francs. Automobiles were imported in the year to the value of 45,000,000 francs alone, while tires amounted to a valuation of 25,235,000 francs.

Summer Courses at Carnegie Tech

Courses in engineering subjects at the Carnegie Institute of Technology, Pittsburgh, Pa., are receiving special attention in the plans for the eleventh summer session which will comprise courses of six and eight weeks, beginning June 11. The study will cover both classroom instruction and shop practice and is designed for those engaged in engineering work as well as for undergraduates.

The College of Engineering will give courses in chemistry, physics, mechanics, surveying and coal mining; College of Industries, plumbing, welding, sheet-metal work, machine practice, woodworking and cabinet making, electric wiring and printing. Other departments will teach English, history, economics, commercial law, mathematics, psychology and engineering drafting.

Furnace and Fuel Oil Specifications Guide

Uniform specifications for the guidance of oil and burner manufacturers and dealers now are ready for release by the American Oil Burner Association, it is announced by that group. These specifications have been compiled from research tests, correspondence and conferences conducted for more than two years with the co-operation of the American Petroleum Institute and the American Society for Testing Materials.

The specifications apply to six types of oil, including light, medium and heavy grades of furnace oil used in domestic heating, and light, medium and heavy grades of fuel oil for industrial use. The requirements cover flash point, amount of water and sediment, distillation range and viscosity. Specifications of nearly 100 oils were examined and tabulated, including almost every type of oil on the market and representing almost every locality.

State Aircraft Exposition

New York State's Aircraft Exposition, the second of its kind to be held in the United States, will open in Syracuse, N. Y., April 30 and continue to May 5, according to a recent announcement by the Syracuse Chapter of the National Aeronautic Association. The exhibition will be held in the State armory and every important manufacturer of aircraft in the United States will be represented. In addition to the commercial planes, pursuit planes of the Army and combat planes of the Navy will be exhibited with various types of engines. Col. Charles Lindbergh, Commander Byrd, and other noted flyers will be sought as guests.

Page Hersey Expansion

Negotiations have been completed whereby the Page Hersey Tubes, Ltd., will take over the plant of the Canadian Baldwin Corporation, Ltd., of Toronto, Canada, at a price estimated to be about $500,000. Gordon Perry, who secured an option on the Baldwin holdings in Canada some time ago, has accepted an executive position on the board of directors of the Page Hersey concern. The expectation is that, as a result of the purchase, a huge steel manufacturing enterprise, embracing lines that are not now available, will be developed in the Ashbridge Bay industrial area. The new owners have a 35-year lease on the property.

Report by General Electric

A summary in part of the annual report of the General Electric Co., Schenectady, N. Y., shows earnings for 1927 amounting to $48,799,488, which is equivalent, after dividends on the special stock, to $6.41 a share on the 7,211,481 shares of no-par-value common stock. This figure compares with $6.14 a share in 1926. Orders received during the year 1927 were $309,784,623 compared with $327,400,207 in 1926, a decrease of 5 per cent. Unfilled orders at the end of the year were $68,916,000 compared with $72,297,000 at the close of 1926, also a decrease of 5 per cent. A comparison of the surpluses for the two-year period gives 1927 a net total of $11,-973,267.93 and 1926 a net total of $17,275,177.69.

Railroad Notes

Wages of shop mechanics, apprentices and a few other classes of workers in New Orleans rail shops will be increased slightly under a new agreement entered into with officers of the association of mechanical department employees. A two-cent-per-hour increase will be granted the workers, while helpers in the shops will get an increase of one cent an hour. A total of 1,700 employees on the Texas & Pacific R.R. and 212 employees of the New Orleans Terminal, which is operated jointly by the T. & P. and the Missouri Pacific, are affected by the increase. A twelve per cent increase was asked.

Aurora, Ill., shops of the Burlington Railroad have started upon a program of construction of a new type of all-steel suburban passenger coaches, which will represent an investment of $600,000, while work upon a $1,000,000 worth of another type of coach, including some wood work, is being completed. Three steel cars are under way and 30 more are scheduled, while 62 composite suburban coaches and five combination coaches have been finished. Future plans are for all-steel coaches. Removal of the locomotive repair shops from Aurora has resulted in development of the plant as a coach building unit with the entire coach being manufactured and assembled under one roof. Under the progressive assembly plan of construction one coach each 10 days is scheduled to be completed.

Important additions and betterments to the Canadian National Railway system amounting to approximately $25,-000,000 are to be carried out this year. This work is provided for in the estimates just tabled in the House of Commons. Of the $25,000,000 of capital expenditure planned, approximately $19,000,000 will be spent in general betterments to the physical property of the railroad and $9,000,000 for 160,000 tons of new rail.

The sum of $275,000 is to be spent on improvements and new equipment for the Oshawa Street Railway, and further improvements are to be made on the Niagara, St. Catherines and Toronto Railway, Canada. More than seven million tie plates will be required for 1928, at a cost of $2,350,000. In the installation of steel bridges and culverts $2,225,000 will be expended, bringing the total amount spent on this account in the past five years to $13,-385,000. On the provision of additional passenger freight, Diesel-electric and work equipment, and in the inustallation of new devices and locomotives and cars, it is planned to spend $5,800,-000 in 1928. Improvements and additions to shops and engine houses are to be carried out during the year, the largest work of this character being planned for the Montreal shops at Point St. Charles, where $1,000,000 will be expended on the new locomotive erecting and machine shop started in 1927, and $450,000 on new power plants for these shops.

S.A.E. Forms Production Committee

A production advisory board, consisting of chief executives in the automotive industry has been formed by the Society of Automotive Engineers. A production committee also has been organized to assist in developing automotive production and to carry on the work actively. This committee is divided into seven groups each of which is to handle a definite class of subjects. One group will promote activities of the regional sections of the society in the matter of meetings for the discussion of production problems. Another is to devote its attention to the development and use of standards in production engineering. Other groups will deal with manufacturing processes and equipment, materials handling, time study and personnel relations, production expenses and inspection methods.

The Business Barometer

The outlook in Commerce, Finance, Agriculture and Industry

By THEODORE H. PRICE

Editor, Commerce and Finance, New York

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"EVERYTHING is going to 500," said a veteran speculator last week as he sat before a blackboard in a stock broker's office, and his remark aptly describes the public attitude toward the greatest boom in the history of finance. It continues to dominate as well as to obscure the commercial situation, and it is entirely appropriate that its latest manifestation should have been a sensational advance in "airplane" stocks. To give the brokers and their clerks a chance to catch up and rest, the Stock Exchange was closed on Good Friday and the succeeding Saturday, but a resumption of activity is expected after the unusual holiday, and there is nothing to indicate that this expectation will be disappointed.

Gold continues to go out in quantity, and the monthly report of the Stock Exchange shows that brokers' loans as of March 31 stood at $4,640,000,000, which is a new high record and $207,000,000 above the previous maximum reached at the end of December last. Interest rates also are higher, and call money has touched 5½ per cent, but it is pointed out that many other bull movements have been unaffected by dear money and it is plausibly argued that brokers' loans are not out of proportion to the increased wealth of the country or the advance in security prices which has added about three billion dollars to the market value of the stocks of 225 major corporations during the month of March.

The widely published statements that the stock market has made three hundred "new millionaires" since the first of January is an example of the gossip by which the imagination of the crowd now is being inflamed, for it inspires thousands with the hope of making a million, although it is manifestly impossible to know how many have made that much or whether having made it they have kept it.

Conservative brokers are trying to put on the brakes by demanding margins that are equal to 33 per cent of the market value of the securities purchased, but these demands are being met and most students of financial history are agreed that sentiment will not be changed until something sensational occurs.

Even this conclusion may be a mistake, for the speculative wind "bloweth where it listeth," but in the days when horses were used a runaway generally led to a crash and neither equine nor human nature has been greatly changed by the development of the automobile or the Federal Reserve Banks. Therefore it seems wisest to keep out of the runaway's probable course, at least for the present, and to avoid creating liabilities that might be onerous if the commodity price level was much changed by either inflation or deflation.

But as a business influence the gyrations of the stock market might be disregarded were it not for the fear that those who have profited by the advance in securities may decide to turn their attention to the staples of human consumption and start a movement which might carry all commodities very much higher.

A week ago there were some indications of such a development. Seats on the commodity exchanges were higher. The grain markets were strong. Sugar was at the top for the year, and "Wall Street" was said to be buying cotton futures. The upward tendency was, however, checked on Wednesday last, when rubber declined six or seven cents a pound on announcement that the British control of exports would be ended on Nov. 30, and sugar eased off a few points because it was assumed that a statement from President Machado meant that Cuba would abandon the policy of crop control after this year. It is not entirely clear that this assumption is warranted, but it has been given wide currency and in the coffee market it was referred to as foreshadowing the time when Brazil will realize that price control costs more than it comes to.

But trade continues quiet and hand-to-mouth buying is still the rule. Car loadings for the week ending March 24 were 6 per cent under last year and the increase in business activity predicted at New Years has not yet been achieved. The steel mills are, however, a little busier, and the automobile people claim that they are selling more cars. Less is heard of unemployment and most of the textile mills appear to be running full time despite the talk of curtailment in the cottom goods trade. This is the picture. It is not entirely cheerful in its hue, but it is not depressing and it might be called satisfactory were it not that prosperity and the plus sign are so inseparably associated in the American mind.

In Europe the Easter season appears to be opening auspiciously. Politically the situation seems to be comparatively tranquil and even in far off China things look as if they were settling down.

Through the loans that are being floated here from day to day American money is being sent to the uttermost parts of the earth, and the financial influence of the United States now is world wide. A recognition of this fact and the power that it implies is at the bottom of the speculation that is so rampant on the Stock Exchange. If it can be restrained and not overdone, all may be well and we should have an autumn of healthy activity. But we will soon be in the throes of a presidential campaign that promises to be a hot one and the political preoccupation of the people during the summer will probably keep their minds off non-essential business at least until October.

WHAT'S DOING IN INDUSTRY

ALTHOUGH the first quarter in retrospect appears to have been spotty, there is every indication of increased business in the next three months. At the present writing conditions vary in different localities. In Cleveland, for example, machine tool trade is quiet, and orders are not up to average. In Detroit the machinery and machine tool market is holding its own at a fairly prosperous level, so good that it is almost impossible to get immediate delivery. In Cincinnati a continued upward trend is noted; in New England buying is more active; in Philadelphia, where the year got off to a slow start, the market is beginning to assume a satisfactory tone; while in Buffalo business is good only for a few concerns.

MACHINES for immediate delivery lead in the Milwaukee market, indicating that no one there is looking very far ahead, but most of the shops are busy and machinists are well employed. Employment in Detroit is also at a high level, largely due to automotive production. Purchases from such shops dominate machine tool buying in Cleveland, Detroit and Cincinnati, but in Milwaukee they are not up to last year's figures.

AN INDEX of general activity in metal-working shops is shown by the fact that in most centers orders are well diversified as to destination. Single items predominate.

The Industrial Review

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

CINCINNATI

The great majority of the machine tool manufacturers in the Cincinnati district report that in the past week there has been a continued upward market trend. The few who did not report at least some increase in sales state that they held their own and express optimism as to the immediate future. The expression of one manufacturer seems to fit the general situation, this being, "Business is good with us, and the only question is how long will it stay at the present level."

Selling agents report that while their business did not increase to any great extent during the week, the general conditions in local territory have improved and prospects are brightening.

The consensus in regard to the recent stock market flurry is that if it had any effect on the machine tool business at all it was merely to cause a relatively small number of timid prospects to postpone buying until the market had become more stable.

An increased volume of business came from the automotive field during the week, some of the orders being fair-sized lists, but the majority being for single tools. The principal buyers were miscellaneous users, located in all sections of the country, who purchased a well diversified assortment of single tools.

An increased number of inquiries were received during the week, of the same character as the orders. The principal inquirers were general machinists and miscellaneous users, located in all parts of the country.

CLEVELAND

Business in the machine tool trade has been very quiet during the last ten days. The present condition was described by a dealer as nothing to cry about or nothing to brag about. Orders booked were not up to the average generally prevailing during the first three months of the year. The manufacturers of automotive products continue to be the leading buyers. Export business showed a little increase. Inquiries are holding up but there is a tendency to delay buying as long as possible. The bright spots in the trade are in the automatic and punch press lines.

The first quarter of the year showed that substantial gains were made by most of the industry over the same period of last year. Twenty to forty per cent increases in sales are reported among those interviewed.

Building permits issued for new factory and workshop construction for March showed a gain of five buildings and a $351,300 gain in cost over March of a year ago.

DETROIT

The machinery market in Detroit, although it is showing no noticeable improvement over the last few weeks, is nevertheless holding its own and presaging better business ahead.

As a matter of fact there has been no better feeling throughout the trade in a great many months than there is at present. Most of the dealers are receiving fair-sized orders and a large number of inquiries. At the present time it is almost impossible for buyers to get immediate delivery on anything.

All of the automobile plants are running at capacity and a great many are farming out much of their work. The smaller shops are all busy and many of them have come into the market for machinery and tools.

The Ford Motor Co. has done considerable buying and has been particularly eager to get equipment for early delivery. Much of the Ford work is being placed outside and at present it seems that the company is making every possible effort to get the maximum of production on its new car.

The general feeling, not only throughout the machinery and machine tool trade but in all fields of business, industry and finance is exceptionally good. Employment still is increasing and there is every likelihood that Detroit will enjoy a most prosperous second quarter.

MILWAUKEE

Pressing needs continue to dominate purchases of metalworking equipment, and the greater part of the new business being placed apparently is for replacement purposes. Industrial construction in this locality remains of a restricted character and opportunities for sales are thereby of a limited nature. It cannot be said that there has been a recession in volume; in fact, the tool market is holding its own in a manner that is considered an indication of improvement. The character and number of inquiries likewise are accepted as meaning more activity in business.

Meanwhile most shops are able to sustain fully their previous output rate, and the employment situation is such that it is not always possible to procure competent labor promptly. The market seems bare of skilled machinists, although it cannot be said that there is a pressing demand.

The bulk of machinery orders specify one or two items, and the purchasers almost invariably use great effort to obtain quick delivery. The sources of business cover a wide variety of industry, with automobile factories showing the greatest interest. As a group, however, this industry is hardly as good a customer as a year ago. Railroad demand is slightly better, but it is far from the accustomed or expected volume.

The used machinery situation shows little change. The influx is not considered abnormal, although the demand is only fair.

NEW ENGLAND

Buyers were more active during the current week in the New England machinery market. Business, however, was by no means brisk, and orders placed were for the most part confined to single items. Inquiries are reported in fairly steady volume; and, at this time, there is every indication that April will be an improvement in many respects over March.

Despite the rosy aspect of the automobile industry (and New England manufacturers in several lines can thank the auto builders for their flying start in 1928), it has not yet reached the optimistic proportions in its relation to the machine tool field, so freely predicted early in the year. It is not likely to.

One large manufacturer of heavy automatic production machinery reasons in this manner: "Economic practices have not been given serious enough consideration in forecasts." A buyer making a popular small car in the Middle West instead of re-equipping, had 450 heavy production automatics retooled to meet the requirements of his new product. The enormous saving effected is believed to be one of the outstanding economic measures ever known in the machine tool industry.

Builders of grinding units, punch presses, wire forming machinery, production lathes and automatics are enjoying a steady business. A sizable list of requirements is expected shortly to equip the new Hartford trade school for which bids are being asked. The Atwater Manufacturing Co., Plantsville, Conn., rushed with orders, contemplates an addition to make automobile parts.

BUFFALO

A spotty condition exists in the machine tool trade of Buffalo. Some of the dealers report business in March to have been better than that of March, 1927, while others are not able to give such a favorable report. With few exceptions, however, inquiries are reported to be somewhat better than was the case a fortnight ago. Optimism still prevails. The fact that this is a presidential election year does not seem to concern any of the dealers in the industry.

In the electrical equipment field conditions, as they have prevailed for the last two months, remain practically unchanged. Small orders are the rule. And it is gratifying to the business that there are so many of them.

There is some improvement in the contracting field. Within a few days of the time this was written the weather moderated markedly and it is anticipated that April will show a marked activity in this branch of the business.

CHICAGO

Machine tool business for the month of March is generally reported to have been better than for the two first months of the year, and the first quarter of 1928 showed a satisfactory advance over the same period in 1927, according to most machinery dealers. Thus far in April no especial activity has developed, the volume of sales remaining on practically the same level as for the last half of March.

Designers and manufacturers of special machinery report that the demand for special equipment still keeps up. Local representatives of machine tool houses as a rule regard the present status of the market with equanimity, expressing themselves as fairly confident that no retrogressive movement will take place, at least before midsummer.

Dealers handling used tools exclusively are doing a fair amount of business, and report numerous inquiries, some of which are for heavy-duty equipment. Railroad buying is without any new features, no lists of budget proportions having been received within the last week or two. The principal demand at present, as for some time past, comes from general industrial sources, with manufacturers of farm implements and tractors leading the specialized industries in volume buying.

PHILADELPHIA

Business in machinery and machine tool lines during the last two weeks has remained on a satisfactory level throughout the Philadelphia area, according to reports from the leaders of the industry. Orders for equipment from general industrial plants throughout Pennsylvania and New Jersey,

and some from firms engaged in the production of automobile accessories, together with a rather healthy list of inquiries from a well scattered area, were factors in the market.

Sales of gear cutters, measuring instruments, abrasives, metal for the production of automobile equipment, shapers, millers and machine shop equipment generally were in the orders received during the past fortnight. In most cases the month of March measured up to expectations, and some of the dealers and producers found that business exceeded the volume of the corresponding month of last year.

The fact that general manufacturers had entered the market was an encouraging sign to most of the producers, as they regard it as indicative of a tendency toward resumption of prosperous conditions. A continued increase in the volume of business is anticipated as the spring months approach.

NEW YORK

Machine tool dealers in the metropolitan district have finally convinced themselves that business is good, although they were reluctant to say so for some time. One firm handling a representative line doubled in March its February business, which had been greater than January. Another firm trebled in March the previous month's figures, while a representative of a single line of tools did as much business in the first quarter as in all of 1927. Another company selling industrial trucks sold in this past quarter a volume equal to the last half of 1927. Other dealers and representatives did a high average business, although in a few cases, of course, there was complaint of lack of orders.

Metal-working shops in the vicinity are said to be slightly under "normal," but with all the buying of equipment that has been going on, further activity is expected. The bulk of the buying in this territory is for single tools, with an occasional large order. One representative sold ten automatics for consignment to a Mid-Western shop, and an unconfirmed rumor is abroad to the effect that an order for twenty lathes was placed.

Machines sold in New York to outside points went to: Gisholt Machine Co., Madison, Wis.; Cleveland Automatic Machine Co.; Helfrect Machine Co., Saginaw; Studebaker Corp., Detroit; Barker Tool & Gauge Co., Detroit; P. K. S. Tool & Manufacturing Co., Los Angeles; F. Schneider & Sons, Brooklyn; Karl Liebernecht, Inc., Reading, Pa.; Brown-Lipe-Chapin, Syracuse; Johnson Gear Co., Berkeley, Cal.; Ford Motor Co.; McClintic-Marshall Co., San Francisco; Spicer Manufacturing Co.; and the Union Paper Bag Co., Seattle.

Of the machines recently delivered to the Fairchild-Caminez Co. on orders placed in the past quarter the following were noted: two Mil-Wau-Kee-Mils, two Warner & Swasey turret lathes, two J & L turret lathes, two Fay automatics, and one Blanchard grinder. The Philadelphia & Reading R.R. recently purchased two 225-ton cranes and one 50-ton crane.

House Asked to Act on Industrial War-Draft Proposal

Immediate consideration by the House of a bill (H. R. 8313), to provide for a general drafting of citizens, material resources and industrial organizations into the service of the federal government in the event of war, was urged in the House, April 5, by Representative Johnson, of Aberdeen, S. D. Declaring the Committee on Military Affairs, to which the measure has been referred, has given it no consideration, Mr. Johnson presented a motion to force a report on the bill and its consideration by House.

"It is sure to be passed at this session," said Mr. Johnson, "as 300 members of this House virtually are pledged to its support. If this bill becomes a law it makes future wars the business of every citizen and exorbitant monetary profits will accrue to no individual or groups."

The bill provides for government control of resources and industrial organizations in an emergency.

Amtorg Purchases Increase

Purchases of industrial equipment by the Amtorg Trading Corporation in March amounted to $2,284,000, the largest figure for this class of purchases for any one month since the opening of Soviet-American trade relations, it was recently announced. Only 23 per cent of the value of purchases was paid for in cash, on the remainder credit terms up to two years being granted. This situation also constituted a record in Soviet-American trade. Total Amtorg purchases for March amounted to $4,400,000 as against the monthly average of $2,700,000 for last year.

Automobile Firms Merge

Completion of the merger of three automobile parts manufacturers is announced by George G. Bouthinon of the Diamond Motor Parts Co., St. Cloud, Minn. Mr. Bouthinon has been elected president and treasurer and general manager of the new organization. The firms taken over by the Diamond concern are the Gill Manufacturing Co. of Chicago, piston ring manufacturers, and the Schlieder Manufacturing Co. of Detroit and Milford, valve manufacturers.

Citroen Engineers Arrive

Paul Vavon, chief engineer of the Andre Citroen Societe Anonyme, and M. M. Houdin, Louis Citroen, Jouffret, Cuinet and Courtin, all of the engineering department of the same company, arrived recently for a tour of research in the automotive industry in this country. They will also make large purchases of plant equipment and machinery.

Cincinnati-Bickford Changes

Announcement is made by the Cincinnati Bickford Tool Co., Cincinnati, Ohio, of the resignation of R. M. Husband, in charge of its advertising department for the last two years. He will take over similar duties with the National Machinery Co., of Tiffin, Ohio. His successor is R. N. Piper, who already has assumed charge of the company's advertising. A farewell party was tendered Mr. Husband and R. L. Rickwood, formerly supervisor of design for the Bickford company and who recently became connected with the new plant of the Cincinnati Enquirer. The occasion also was in the nature of a welcome to Mr. Piper and Thomas Addison, the latter having succeeded Mr. Rickwood as supervisor of design. Among those attending the occasion were: D. C. Klausmeyer, George P. Gradolf, N. C. Schauer, C. C. Slete, O. E. Schauer and August H. Tuechter.

Personals

GORDON PERRY, president of the National Iron Corporation, Toronto, has been elected a member of the board of directors of Page-Hersey Tubes, Ltd., Toronto.

G. R. SOUTHEE has been appointed district sales manager in charge of the Ontario division of the Canadian Ingersoll-Rand Co., Ltd., Montreal.

DWIGHT RUTH has resigned as assistant treasurer of the Saranac Machine Co., of Benton Harbor, Mich., and will become associated with the Moulds Brass Co., of that city.

DAVID H. PRESTON has become assistant general sales manager of the Excello Tool & Manufacturing Co., of Detroit, Mich.

H. C. WHITE has been appointed works manager of the Western Harvester Co., of Stockton, Calif., where he formerly was in charge when the plant was operated by the Holt Manufacturing Co.

F. P. WALSH has been appointed manager of the Crane department of the Whiting Corporation, of Harvey, Ill., and R. H. MOORE has been appointed manager of the foundry equipment department of that concern.

W. C. STETTINIUS, of Baltimore, Md., has been elected a director of the Worthington Pump and Machinery Corporation, of New York City. E. T. Fishwick, vice-president of the company also was elected to the board.

ROBERT K. GREAVES has been appointed Detroit district manager in charge of sales of tool and special steel and metal cutting saws for Henry Disston & Sons, Inc., Tacony, Philadelphia. His headquarters will be at 629 Hancock Street.

EDWARD S. WINSLOW has been appointed assistant general manager of the Canadian Ingersoll-Rand Co., Ltd. Mr. Winslow entered the employ of the company sixteen years ago and served in various capacities at its factory and branch office. For several years he has been general sales manager, in which capacity he is succeeded by William Carter.

RALPH N. SOURBECK, formerly sales engineer of the Clarkson Coal & Dock Co., of Cleveland, Ohio, now is affiliated with the Cleveland Duplex Machinery Co., Inc., in charge of the surplus machinery department. Mr. Sourbeck will devote his time to the purchase and liquidation of industrial plants and supervising the rebuilding of machine tools.

DUDLEY V. WALKER, formerly sales agent for the Vulcan Iron Works, New Britain, Conn., has been appointed general manager of the Malleable Iron Works, New Britain, to succeed Frank Miller. The Vulcan and the Malleable Iron Works are owned by the Eastern Malleable Iron Co., of which George E. Bean is general manager.

W. S. SLANGERUP, formerly engaged in the foundry and machinery business at Mineral Wells, Tex., is named president of the re-organized company which will hereafter operate as the Breckenridge Foundry & Supply Co., moving its plant from Mineral Wells to Breckenridge, where a new plant is being erected.

R. H. MULCH, president of the Ontario Tractor Co., Ltd., Toronto, has been appointed sales manager of the Chrysler Corporation of Canada, Ltd., Windsor, Ontario. Mr. Mulch, who has been associated with the automotive industry for more than 20 years, organized the Ontario Tractor Co. about twelve months ago. He will still retain his connection with that company.

W. H. NORRINGTON has been appointed by the C. O. Bartlett & Snow Co., Cleveland, Ohio, as representative in New York City and vicinity with offices at 30 Church St. Mr. Norrington served two years with the manufacturing division of the Republic Rubber Co., of Youngstown, Ohio. In 1914 he became sales engineer for the Robins Conveying Belt Co., and in 1921 was appointed its general manager, holding that office until Jan. 21, last.

H. A. HAIR, formerly sales engineer for the Whiting Corporation of Harvey, Ill., has been appointed manager of railroad sales of the Watson-Stillman Co., of New York City, with offices at 75 West Street. Since his graduation in mechanical engineering from Purdue University he has had wide experience in railroading and railroad supplies and has served as mechanical engineer on the Baltimore & Ohio and Susquehanna & Western Railroads.

O. W. YOUNG, formerly with the Western Division sales office of the Hyatt Roller Bearing Co., has been appointed chief engineer of that concern and has assumed his duties at its headquarters in Newark, N. J. Mr. Young joined the Hyatt company in 1915 as sales engineer and then took charge of engineering activities of the Western Division. For the last two years he had been assistant manager, covering sales of the tractor and agricultural equipment industry.

COL. JAMES L. WALSH has resigned as vice-president of the McGraw-Hill Publishing Co., of New York City, to become a vice-president and member of the board of directors of the Guardian Detroit Bank of Detroit, Mich. He will retain his membership on the board of directors of the McGraw-Hill organization. Previous to entering the publishing field, Col. Walsh was for many years with the Bankers' Trust Co., serving as resident officer in Chicago in charge of all business in the Middle West. He is a member of the finance committee of the American Society of Mechanical Engineers and chairman of its national defense division.

Business Items

The Chicago office and salesroom of the United States Electrical Tool Co., of Cincinnati, E. C. Price, district manager, have been removed from 541 W. Washington Boulevard to 549 West Washington Boulevard.

The Doehler Die Casting Co., 549 Washington Boulevard, Chicago, has been incorporated in Illinois to manufacture and deal in die castings of all kinds. The incorporators are F. H. O'Connor, Rex Dennant and Henry Hagemeyer.

The I. Greenbaum & Sons Co., Inc., of 64 East 116th St., New York City, for several years engaged in the heating and plumbing supply business, have opened a machinery and tool division and will be distributors for several manufacturers of modern machine tool equipment.

The Bryant Electric Co., of Bridgeport, Conn., has purchased full control of the Hemco Electric Manufacturing Co., also of that city. All trade marks, patents and processes are included in the transaction. The Bryant concern has been manufacturing wire devices, metal shell and porcelain lamp receptacles, sockets and their accessories and the like for more than 40 years.

The City Machine & Tool Works, of Dayton, Ohio, announces the purchase of all rights to the Peerless gear chamfering machine, formerly manufactured by the Peerless Machine Co., of Muncie, Ind. Sales will be under the direction of the City Machine & Tool Works and the National Broach Co., the latter concern being affiliated with the former.

The Corpus Christi Foundry & Machine Co., Corpus Christi, Tex., machinery manufacturers and distributors, was recently acquired by San Antonio interests who have changed the name of the company to the Luckett Foundry & Machine Co., and will continue operation of the plant after making extensive improvements. H. L. Luckett is president and manager of the new company.

The Hazard Wire Rope Co., of Wilkes-Barre, Pa., has been granted a license to manufacture the "Tru-Lay" perforated wire rope and the "Tru-Loc" processed fitting under license of the American Cable Co., Inc. The Hazard company has for many years been recognized as a high-grade manufacturer of wire rope and probably is the oldest manufacturer in its line in the United States.

The Roller Bearing Company of America, 141 Frelinghuysen Ave., Newark, N. J., shortly will transfer its operations to the plant formerly occupied by the Mercer Motor Car Co., of Newark. The announcement points out that 100 men will be employed immediately. Joseph C. Trainer, of Philadelphia, is president of the company. Other officers are David H. Litter, Emanuel Scheck, Allan Jones and John J. Berliss.

The Wright Manufacturing Co., of Lisbon, Ohio, manufacturer of chain hoists, trolleys and cranes, announces the sale of its business and trade name to the American Chain Co., Inc., of Bridgeport, Conn. There is no anticipated change in policies or the sales organization of the Wright company. H. F. Wright and W. F. Wright will continue in their respective divisions of sales and production of Wright products.

With the incorporation of the Lyons Metal Products, Inc., of Aurora, Ill., the merger of the Lyons Metallic Manufacturing Co., of Aurora, the Durant Co., of Chicago, and the Fred. Medart Manufacturing Co., of St. Louis, goes into effect with a capital stock of $4,000,000. F. S. Waters, of Aurora is to be president, Keith Spaulding, of Los Angeles, and W. N. Vance, Chicago Heights, vice-presidents; B. L. Waters, Aurora, secretary and W. S. Brown, Chicago, treasurer. Headquarters of the new organization will be in Aurora and it will engage in the manufacture of steel lockers, office furniture and store fixtures.

The Bilton Machine Tool Co., of Bridgeport, Conn., was acquired by a new organization for $500,000 at a receivers sale on April 3. The new concern will operate as the Producto Machine Co. with the following officers: Newman M. Marsilius, president and general manager; E. A. Harter, A. J. Cummings, E. J. Rogers, vice-presidents; George H. Webber, secretary and treasurer; R. F. Lathe, assistant secretary-treasurer. William J. Grippin is chairman of the board of directors. Clarence E. Bilton, founder of the originial Bilton Machine Tool Co., and more recently connected with the American Chain Co., has announced that he is working on details for establishing a new organization to manufacture short-cut automatic milling machinery.

Obituaries

LEROY PARDEE NEEDHAM, district manager of Wheelock, Lovejoy & Co., Inc., of Chicago, Ill., died recently following an operation. He was graduated in civil engineering from Pennsylvania State College in 1915, and served in the Ordnance Corps in the World War as inspector of steels.

DAVID H. DARRIN, president of the Automatic Switch Co., of New York, died recently at his home in New Rochelle, following an illness of several months. Mr. Darrin was one of the veteran members of the American Society of Mechanical Engineers and was a life member of that organization. He also was a member of the Engineers' Club.

CHARLES S. SMITH, former vice-president of the A. O. Smith Corporation of Milwaukee, Wis., maker of pressed steel automobile frames and oil well equipment, died recently in Bermuda in his 67th year. Early in his career he became associated with his father and brother in the C. J. Smith & Sons Co., manufacturer of bicycle parts; the business later becoming the A. O. Smith Corporation.

COL. WILLIAM HENRY MORGAN, president of the Morgan Engineering Co., of Alliance, Ohio, noted pioneer in the electric traveling crane industry, died recently in Baltimore in his 63rd year, following an operation. In 1877, his father, Thomas R. Morgan, Sr., founded the present company to manufacture steel mill and handling equipment. After the death of his father in 1897 the deceased became president of the company.

Forthcoming Meetings

American Gear Manufacturers' Association. Twelfth annual meeting, Rochester, N. Y., April 19, 20 and 21, Hotel Seneca. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland, Ohio.

American Welding Society. Annual meeting, week of April 23, New York City. M. M. Kelly, secretary, 33 West 39th Street, New York City.

National Metal Trades Association. Thirtieth annual meeting, Hotel Astor, New York, April 25 and 26. J. E. Nyham, secretary, Peoples Gas Bldg., Chicago, Ill.

National Foreign Trade Council. Fifteenth anniversary convention, Houston, Texas, April 25, 26 and 27. O. K. Davis, secretary, India House, Hanover Square, New York.

American Society of Mechanical Engineers. Spring Meeting, May 14-16, Pittsburgh, Pa. Calvin W. Rice, secretary, 39 West 39th St., New York City.

American Foundrymen's Association. Convention and Exhibit, Philadelphia, May 14 to 18. Technical Sessions at Hotel Belleview-Stratford; exhibit at Commercial Museum. R. E. Kennedy, secretary, 140 So. Dearborn St., Chicago.

Southern Supply & Machinery Dealers' Association. Will meet in annual convention in Nashville, Tenn., May 15, 16 and 17 jointly with the **National Supply & Distributors' Association** and the **American Supply & Machinery Manufacturers' Association.**

National Association of Purchasing Agents. Annual meeting and "Informashow," Kansas City, Mo., May 28 to 31. W. L. Chandler, secretary, 11 Park Place, New York.

American Railway Association. Schedule of sectional meetings: Division V, Mechanical, June 13 to 20, Atlantic City, N. J.; Division VI, Purchases and Stores, June 13 to 15, Atlantic City, N. J. Division VII, Electrical, Sept. 22 to 28, Cleveland, Ohio. J. W. Welsh, secretary, 292 Madison Avenue, New York City.

Association of Iron and Steel Electrical Engineers. Annual meeting, Stevens Hotel, Chicago, June 25 to 29. J. F. Kelly, managing director, Empire Bldg., Pittsburgh, Pa.

American Society for Testing Materials. Annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 25 to 29. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia, Pa.

Society of Automotive Engineers. 1928 Summer Meeting, Chateau Frontenac, Quebec, Canada, June 26 to 29. C. E. Heywood, in charge of meetings, 29 West 39th St., New York.

American Railway Tool Foremen's Association. Annual meeting, Hotel Sherman, Chicago, Sept. 12, 13 and 14. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foreman's Association. Sixteenth annual convention of the Supply Association, Hotel Sherman, Chicago, Sept. 12, 13 and 14. F. A. Armstrong, secretary, the Pratt & Whitney Co., 564 W. Monroe St., Chicago.

National Safety Council. Seventeenth annual safety congress will be held in New York, October 1-5. Idabelle Stevenson, executive secretary, 1 Park Ave., New York.

American Society for Steel Treating. "National Metals Exposition," Commercial Museum, Philadelphia, Pa., week of Oct. 8. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

The Weekly Price Guide

Rise and Fall of the Market

MILL operations are at the rate of 85 to 90 per cent of capacity in the steel industry, having shown a slight gain in the last week. A sufficient amount of current buying is in evidence, in automobile bars and strips, railway passenger car material, plates, sheets and wire nails, to lend firmness to steel quotations. Wrought-steel and cast-iron pipe consumption is seasonally active, with five points dropped from the discounts on direct shipments in the former and a rise of $1 per ton at Birmingham and Burlington on the latter. Fabricated copper together with scrap brass and copper are higher than a week ago. Pig iron buying continues in small lots with prices steady. The coke market also shows improvement.

(All prices as of April 6)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$21.44
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	25.62
BIRMINGHAM	
No. 2 Foundry	16.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.76
Virginia No. 2	27.17
Basic	21.26
CHICAGO	
No. 2 Foundry local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	22.80
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	20.26
Basic	19.26
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.50@4.75
Cleveland	5.00
Cincinnati	4.30
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.10@2.20	3.50	3.25	3.89
No. 12	2.15@2.25	3.55	3.30	3.94
No. 14	2.20@2.30	3.60	3.35	3.99
No. 16	2.30@2.40	3.70	3.45	4.09
Black				
Nos. 18 to 20	2.60@2.70	3.75	3.55	4.00
No. 22	2.75@2.85	3.90	3.70	4.15
No. 24	2.80@2.90	3.95	3.75	4.20
No. 26	2.90@3.00	4.05	3.85	4.30
No. 28	3.05@3.15	4.20	4.00	4.45
Galvanized				
No. 10	2.95@3.05	4.10	3.90	4.25
Nos. 12 to 14	3.05@3.15	4.20	4.00	4.35
No. 16	3.15@3.25	4.30	4.10	4.45
No. 18	3.30@3.40	4.45	4.25	4.60
No. 20	3.45@3.55	4.60	4.45	4.75
No. 22	3.50@3.60	4.65	4.50	4.80
No. 24	3.65@3.75	4.80	4.60	4.95
No. 26	3.90@4.00	5.05	4.85	5.20
No. 28	4.15@4.25	5.30	5.10	5.45

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

WROUGHT STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb.:

Thickness—Decimal	B.w.g. and Fractions	Outside Diameter in Inches—⅛	¼	⅜	½	⅝	¾	1	1¼	1½
		Price per Foot								
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23		
.049″	18	.17	.18	.19	.20	.21	.23	.25		
.065″	16	.19	.20	.21	.22	.23	.25	.27		
.083″	14	.20	.22	.23	.24	.25	.27	.29		
.095″	13	.21	.23	.25	.26	.27	.29	.31		
.109″	12	.22	.24	.26	.27	.28	.30	.32		
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33		
.134″	10	.24	.26	.28	.29	.30	.32	.34		

MISCELLANEOUS—Warehouse base prices in cents per lb.:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.49	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.25	5.30	5.00
Cold drawn, round or hexagon†	3.40	3.65	3.60
Cold drawn, flat or square†	3.90	4.15	4.10
Structural shapes	3.34	3.00	3.10
Soft steel bars	3.24	3.00	3.00
Soft steel bar shapes	3.24	3.00	3.00
Soft steel bands	3.99	3.65	3.65
Tank plates	3.34	3.00	3.10
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, 3/16@½-in. thick. †Cold finished steel, shafting and screw stock.

Electric welding wire, New York, 3/32, 8.35c.; ⅛, 7.85c.; 5/32 to ¼ 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:

Copper, electrolytic, New York			15.50
Tin, straits, pigs, New York			55.00
Lead, pigs, E. St. Louis	6.00	New York	7.00
Zinc, slabs, E. St. Louis	5.75	New York	6.75

	New York	Cleveland	Chicago
Antimony, slabs	12.50	13.25	14.25
Copper sheets, base	22.75	23.00	22.75
Copper wire, base	19.37½	19.62½	16@16¼*
Copper bars, base	21.25	21.50	22.25
Copper tubing, base	24.50	24.50	24.50
Brass sheets, high, base	18.75	18.75	18.75
Brass tubing, high, base	23.62½	23.62½	23.62½
Brass rods, high, base	16.50	16.50	16.50
Brass wire, high, base	19.25	19.50	19.25

*Mill.

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%.....	27@28*	22¾@24	24.30
Zinc sheets (casks).....	9@ 9½	11.20	10.36
Solder (⅛ and ¼), (case lots).....	34.00	32.50	33@37
Babbitt metal, delivered, New York, cents per lb.:			
Genuine, highest grade.....			71.00
Commercial genuine, intermediate grade.....			57.00
Anti-friction metal, general service.....			31.50
No. 4 babbitt (f.o.b.).....			12.00
Nickel, f.o.b. refinery, cents per lb.:			
Ingots..... 35.00	Electrolytic.. 37.00	Shot.....	36.00

*Delivered.

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Full finished nickel sheet (base).....	52.00
Cold rolled nickel sheet (base).....	60.00
Hot rolled rods, Grade "A" (base).....	45.00
Cold drawn rods, Grade "A" (base).....	53.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot.....	28.00	Hot rolled rods (base)...	35.00
Blocks.....	28.00	Cold drawn rods (base)..	43.00
Cold rolled sheets (base)	50.00	Full finished sheets (base)	42.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible copper.....	12.37½@12.62½	11.50	11.25@11.75
Copper, heavy, and wire..	11.50 @12.37½	10.75	10.75@11.25
Copper, light, and bottoms	10.25 @10.75	9.50	9.50@10.00
Heavy lead.....	4.75 @ 5.00	5.25	4.25@ 4.75
Tea lead.....	3.50 @ 3.75	3.75	3.25@ 3.75
Brass, heavy, yellow.....	7.12½@ 7.37½	7.25	7.00@ 7.50
Brass, heavy, red.....	9.25 @ 9.75	9.75	9.00@ 9.25
Brass, light.....	5.50 @ 5.75	5.75	6.00@ 6.50
No. 1 yellow rod turnings.	7.50 @ 8.00	7.50	7.00@ 7.50
Zinc.....	3.25 @ 3.50	3.25	2.50@ 3.00

TIN PLATES—Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20.....	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20.....	9.70	9.90	9.50
	Coke Plates—Primes—Per box			
100-lb.,	14x20.....	6.45	6.10	7.00
	Terne Plates—Small lots, 8-lb. Coating—Per box			
IC,	14x20.....	7.75@8.00	5.30	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.‡	$0.10@0.13½	$0.16	$0.15
Cotton waste, colored, per lb.‡	.09@ .13	.12	.12
Wiping cloths, washed white, per lb.....	.15@.17½	38.00 per M	.15
Sal soda, per lb.....	.02	.02	.02¾
Roll sulphur, per lb.....	.027	.03½	.04
Linseed oil, raw, per 7½-lb. gal., 5 bbl. lots.....	.76½	.84	.78
Lard cutting oil, 25% lard, in 5 gal. cans, per gal....	.65	.55	.55
Machine oil, medium-bodied (55 gal. steel bbl.) per gal.....	.30	.36	.26
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin.ft. per inch of width for single ply			
Medium grade.....	35%	35%	35%
Heavy grade.....	30%	30%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft.			
First grade.....	45%	50–10%	50%*
Second grade.....	50%	60–5%	50–10%†

*Large quantities, 60%. †Large quantities, 60–10% ‡Bale lots.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb.....	$0.0324	$0.0324	$0.0324
Cold drawn shafting....	per lb.....	.034	.034	.04
Brass rods.....	per lb.....	.165	.165	.1612½
Solder (½ and ¼).....	per lb.....	.34	.3325	.42
Cotton waste, white....	per lb.....	.10@.13½	.10@.13½	.10@.13½
Emery disks, cloth, No. 1, 6-in. dia.....	per 100...	3.10	3.10	3.10
Lard cutting oil.....	per gal...	.65	.65	.55
Machine oil.....	per gal...	.30	.30	.33
Belting, leather, medium.....	off list....	35%	35%	40–5%
Machine bolts, up to 1x30 in., full kegs....	off list...	50%*	50%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
*Flint paper.....	$5.40	$4.95	$5.13
*Emery paper.....	10.71	9.15	10.71
*Emery cloth.....	27.84	27.85	27.84
Emery disks, 6 in. dia., No. 1, per 100:			
Paper.....	1.29	1.27	1.32
Cloth.....	3.10	3.05	3.05
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton...	Connellsville, 2.65@3.00		
Coke, prompt foundry, per net ton...	Connellsville, 3.75@4.50		
White lead, dry or in oil...	100 lb. kegs....	New York, 13.75	
Red lead, dry.....	100 lb. kegs....	New York, 13.75	
Red lead, in oil.....	100 lb. kegs....	New York, 15.25	

*4½ reams and under.

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

	Full Kegs or Cases
Machine bolts, square heads and nuts:	
Up to ¾ x 6-in.....	55%
Larger up to 1 x 30-in.....	50%
1⅛ and 1¼ in. dia.....	35%
Carriage bolts:	
Up to ½ x 6-in.....	55%
Larger sizes.....	50%
Coach and lag screws:	
Up to ½ x 6-in.....	55%
Larger sizes.....	50%
Tap bolts, hexagonal heads.....	40%
Nuts:	
Hot pressed, square and hexagonal, blank or tapped, up to 1-in., incl.....	55%
Cold punched, square and hexagonal, blank or tapped, up to 1-in. incl.....	55%
Semi-finished, hexagonal, tapped, in packages, all sizes.....	40%
Case hardened, hexagonal, tapped, in packages, all sizes.....	30%
Washers: Deduct from list, per 100 lb.....	$3.50*
Rivets, button and cone head:	
Small, including ⅛-in. dia.....	50–10%
Large (base) per 100 lb. net.....	$5.00†

Note—For less than case or keg quantities on bolts, screws, hot-pressed and cold-punched nuts, add extra of 10 per cent to list.
*Broken keg lots, $1.50 off list. †Broken keg lots, $6.50 net.

Machine Requirements and Industrial Construction

Equipment Wanted

Ill., Chicago—E. M. Laird Airplane Co., 4500 West 83rd St.—machinery and equipment for proposed machine shop.

Mich., Detroit—Bohn Aluminum & Bronze Co., Isobel St.—equipment for finishing aluminum castings for proposed 1 story, 50 x 316 ft. aluminum products factory.

Mich., Detroit—Frederick Colman & Sons, 7250 Central Ave.—planer.

Mich., Detroit—Gairing Tool Co., 19 West Woodbridge St.—Universal grinder.

Mich., Detroit — White Motor Co., 842 East 79th St., Cleveland, O.—machine shop equipment for service department of proposed 1 story, 190 x 200 ft. sales and service station here. Estimated cost $150,000.

O., Cleveland—Bd. of Education, East 6th St. and Rockwell Ave.—one 10 in. sensitive drill and one hand shaper for Alexander Hamilton Jr. high school.

O., Newark—Wolrath Mfg. Co., O. M. Walrath, Pres. (auto parts and accessories) —complete equipment including lathe, grinding machine, automatic drill, etc. for new shop.

Pa., Pittsburgh—Carnegie Steel Co., Carnegie Bldg.—two 15 ton cranes for Duquesne works.

Pa., Pittsburgh—Pittsburgh Plate Glass Co., Frick Bldg.—six overhead electric cranes.

Tex., Corpus Christi—Luckett Foundry & Machine Co., H. L. Luckett, Mgr.—machinery and equipment for recently acquired plant.

B. C., Port Albernia — Dept. of Public Wks., Ottawa, Ont., S. E. O'Brien, Purch. Agt.—will receive bids until May 8 for a 4 ton electrically operated traveling crane for assembly wharf here.

Opportunities for Future Business

Calif., Los Angeles—W. Beamish, c/o C. C. Ruppenthal, 1065 North Vine St., is receiving bids for a 1 story, 150 x 215 ft. garage on 5th St.

Calif., Los Angeles—Krempel & Erkes, Bank of Italy Bldg., Archts., are receiving bids for a 1 story factory including, 115 x 177 ft. phonograph record manufacturing department, 115 x 117 ft. storage warehouse, etc. on Mines Ave. for Brunswick-Balke Collendar Co., 855 South Los Angeles St. Noted Jan. 13.

Calif., Los Angeles—Floco Motors Corp., F. L. Odenbrite, Pres., 138 West 17th St., plans the construction of first unit of factory, 1 story, 100 x 150 ft.

Calif., Santa Monica—Douglas Co., c/o L. B. Norman, 1325 Georgina Ave., Contr., awarded contract for a 1 and 2 story, 240 x 375 ft. factory for the manufacture of airplanes at Ocean Park Blvd. Estimated cost $80,000.

Ga., Atlanta—Palmer Inc., Palmer Bldg., is having plans prepared for a 5 story, 88 x 113 ft. garage at Spring and Marietta Sts. Burge & Stevens, 101 Marietta St., Archts. Noted Mar. 15.

Ind., Fort Wayne—International Harvester Co., plans the construction of a warehouse including garage and service station, etc. Estimated cost $750,000.

Ind., Fort Wayne—Truck Engineering Co., East Pontiac St., awarded contract for a 1 story, 60 x 100 ft. factory. Estimated cost $41,000. Noted Nov. 17.

Mass., Beverly—Winer Bros., 193 Rantoul St., is receiving bids for a 1 story repair and service garage. Estimated cost $40,000. Private plans.

Mass., Cambridge (Boston P. O.)—Cambridge Salvage & Supply Co., 91 Broadway, is having plans prepared for a 2 story, 80 x 100 ft. factory and storage building at Broadway and Jordan Pl. Estimated cost $70,000. N. R. Willard, 402 Massachusetts Ave., Arlington, Archt.

Mass., Malden (Boston P. O.)—Caldwell Building Trust, 204 Pleasant St., had plans prepared for a 1 story, 100 x 100 ft. repair shop, etc. on Exchange St. Estimated cost $40,000. C. F. Springall, 84 Sprague St., Archt.

Mass., Salem—Townsend Motor Car Co., R. Townsend, Derby St., awarded contract for a 1 story, 70 x 210 ft. repair and service garage. Estimated cost $65,000. Noted Mar. 15.

Mass., Quincy (Boston P. O.) — K. A. Karjalainen, 23 Greenwood Ave., had plans prepared for a 2 story, 40 x 100 ft. auto repair shop in Wollaston Dist. Estimated cost $40,000. R. B. Whitten, 101 Tremont St., Boston, Archt.

Mass., Springfield—Fort Realty Co., c/o H. C. Hearne, 1389 Main St., Archt., will soon award contract for a 3 story, 110 x 145 ft. garage at Fort Columbus Ave. and Hampden St. Estimated cost $300,000. Noted Feb. 9.

Mass., Waltham (Boston P. O.)—T. Sullivan, 365 Main St., is receiving bids for a 2 story, 60 x 100 ft. repair and service garage on Main St. Estimated cost $50,000. W. H. Gaines, 32 Riverview Ave., Archt. Noted Jan. 12.

Mich., Detroit—Chevrolet Motor Car Co., Holbrook Ave., awarded contract for a 1 story, 400 x 800 ft. addition to gear and axle factory.

Mich., Jackson—Sparks-Withington Co., awarded contract for the construction of a 2 story, 60 x 260 ft. factory for the manufacture of horns and radio receiving sets.

Minnesota — State Commission of Administration & Finance, State Capitol, St. Paul, will receive bids until Apr. 17 for the construction of five maintenance shop buildings, offices, etc. at Mankato, Owatonna, St. Cloud, Marshall and Windom. Estimated cost $30,000 each. Private plans.

Minn., Minneapolis — Northwestern National Bank, E. W. Docker, Pres., Marquette Ave. and 4th St., and L. S. Donaldson Co., J. Chapman, Pres., 6th St. and Nicollet Ave., plan the construction of a 5 story garage at 6th and Marquette Ave. Estimated cost $400,000. Graham, Anderson, Probst & White, 80 East Jackson Blvd., Chicago, Ill., Archts.

Mo., Jefferson Barracks (br. St. Louis)—U. S. Veterans Bureau, Washington, D. C., awarded contract for the construction of a new shop building. Estimated cost $41,900. Noted Mar. 22.

Neb., Reno—Washoe County, is having preliminary plans prepared for the construction of a repair shop and storage building. Ferris & Son, Cladianos Bldg., Archts.

N. J., Newark—Meeker Holding Co., 1060 Broad St., awarded contract for a 3 story, 100 x 100 and 55 x 155 ft. garage at 403 Elizabeth Ave. Estimated cost $150,000. Noted Mar. 8.

N. Y., Brooklyn—A. Brody, 845 Albany Ave., had plans prepared for a 1 story, 120 x 125 ft. garage at Gravesend Ave. and Ave. F. Estimated cost $50,000. M. A. Cantor, 66 Court St., Archt.

N. Y., Brooklyn—Newbrook Builders Inc., R. Cantor, Pres., 195 Jefferson Ave., will build a 1 story, 100 x 125 ft. garage and gas station at 8th and Roebling St. Estimated cost $45,000. M. Klein, 65 Court St., Archt.

N. Y., New York—Aucofein Realty Co., S. Feinberg, Pres., 440 East 170th St., had plans prepared for a 2 story, 54 x 250 ft. garage at Webster Ave. and 210th St. Estimated cost $65,000. T. F. Price, 243 West 231st St., Archt.

N. Y., New York—Cyclops Co. Inc., 355 East 149th St., had plans prepared for a 2 story 100 x 147 ft. garage at White Plains Ave. and Wilgus St. Estimated cost $50,000. C. Kreymborg, 2534 Marion Ave., Archt.

N. Y., New York—Farlour Associates, 1440 Broadway, had plans prepared for a 1 story, 101 x 169 ft. garage at Windercliffe Ave. and 175th St. Estimated cost $50,000. G. G. Miller, 1482 Broadway, Archt.

N. Y., New York—R. H. Macy & Co., Broadway and 34th St., had plans prepared for a 2 story, 98 x 100 ft. garage at 528 West 39th St. Estimated cost $200,000. R. D. Kohn, 56 West 45th St., Archt.

N. Y., New York—P. J. Murphy, 831 Cedar Ave., had plans prepared for a 1 story, 85 x 261 ft. garage at Cedar Ave. and Tremont St. Estimated cost $50,000. M. J. Ort, 424 East 149th St., Archt.

N. Y., St. George (Staten Island P.O.)—F. Coonley, 107 Central Ave., had plans prepared for a 6 story, 75 x 100 ft. garage at Montgomery St. and Fort Pl. Estimated cost $150,000.

N. Y., Queens (Jamaica P. O.)—Dept. of Parks, will soon awarded contract for the construction of a garage at Forest Park.

N. Y., Woodside—I. Levin, 551 5th Ave., New York, had plans prepared for a 1 story, 100 x 200 ft. garage at Polk Ave. and Third St. here. Estimated cost $100,000. Berlinger & Kaufman, 66 5th Ave., New York, Archts.

N. C., Charlotte—City, awarded contract for the construction of a 1 story, 115 x 302 ft. garage on Seigle Ave. Estimated cost $64,940.

N. C., Charlotte—Enfield-Norfleet Co., awarded contract for a 50 x 132 and 60 x 150 ft. garage. Estimated cost $75,000.

O., Cleveland—Acme Auto Radiator Co., J. T. Bares, Mgr., 7707 Carnegie Ave., is receiving bids for a 1 story, 36 x 176 ft. factory at 7120 Carnegie Ave. Estimated cost $60,000. T. E. Cerny, 4025 East 52nd St., Archt. Noted Mar. 22.

O., Cleveland—Bd. of Education, F. G. Hogan, Dir., is having plans prepared for a 1 story foundry on Eagle Ave. Estimated cost $40,000. G. M. Hopkinson, Auditorium Garage Bldg., Archt.

O., Cleveland—Scott & Fetzer Co., J. H. Scott, Pres., 11401 Locust Ave., manufacturers of vacuum cleaners, awarded contract for a 2 story, 40 x 60 ft. addition to factory. Estimated cost $40,000. Noted Mar. 22.

Pa., Pittsburgh — Lawson Mfg. Co., 300 North Lexington Ave., manufacturers of gas burners and water heaters, awarded contract for a 1 story, 50 x 280 ft. addition to factory. Estimated cost $40,000.

Pa., Pittsburgh—J. McHugh, Delafield Heights, Aspinwall, awarded contract for a 1 story, 90 x 160 ft. work shop on Center Ave. Estimated cost $40,000.

R. I., Providence—B. Brier, 15 Upton Ave., is having plans prepared for a repair garage, etc. at Eddy Dorance and Friendship Sts. Estimated cost $40,000. F. B. Perry, 44 Franklin, Archt.

Tex., Cleburne—Gulf & Colorado & Santa Fe Ry. Co., Galveston, awarded contract for a 1 story, 202 x 515 ft. shop here. F. Merritt, Ch. Engr.

Tenn., Knoxville—City, awarded contract for a 1 story garage, etc. on North 5th Ave. Estimated cost $100,000. Noted Mar. 22.

B. C., Vancouver — Vancouver School Board, will soon award contract for a 4 story technical school including 133 x 283 ft. workshop, etc. at Broadway E. and Clinton St. Estimated cost $500,000. W. H. Postle, 590 Hamilton St., Archt. P. P. Brown, 407 London Bldg., Engr. Noted Mar. 22.

Man., Winnipeg — Northwestern Metalwares, will soon receive bids for addition to factory at Erie and St. Matthews Aves.